JOURNAL

OF THE

Department of Agriculture

OF

WESTERN AUSTRALIA.

Vol. 15. (Second Series) MARCH, 1938. No. 1.

PREPARING FOR THE EXPORT LAMB SEASON.

F. L. Shier,
Agricultural Adviser.

The production of export lambs of prime quality is of vital importance in placing this industry on a firm footing and establishing a reputation on the London market for quality meat. Last season many consignments from this State brought outspoken praise from authorities overseas. This State exported last season approximately 280,000 lambs, of which approximately 29 per cent. were first-grade. In 1937 82 per cent. of the lambs from the Avondale Research Station treated for export graded first-grade, whilst many prominent producers had similar returns. These figures speak for themselves and need little comment. It is felt, however, that the State's figure can be improved considerably.

A good reputation will assist materially in the disposal of our lambs at satisfactory prices on the overseas market, and this is of greater importance should the market ever become over-supplied and more discrimination be exercised by the buyers. A good name cannot be attained except on quality.

The production of prime quality lambs depends mainly on two factors, firstly breeding and secondly feeding. These two factors are equally important, and if either one is not of a high standard, then a large percentage of first-grade lambs cannot be expected.

It is not proposed to discuss at this stage the merits and demerits of the different breeds and crosses; this factor has already been determined for the coming season's drop. It is proposed, however, to suggest some points for consideration, such as feeding and care and attention, which it is hoped will assist in the placing on the market this year of the greatest possible number of first-grade lambs.

Feeding the Ewe.

Whilst it has been shown that an improving state of nutrition is the most favourable for obtaining a high percentage "drop," it is generally not well known that during the bulk of the gestation (in lamb) period the ewe has very little extra food requirements above maintenance. It is only necessary to keep her in good healthy store condition. During the last third of pregnancy, however, the ewe has definite extra food requirements, firstly to provide for the developing foetus, and

secondly to stimulate the growth of the milk-producing tissue of the udder. The lamb in the first three months of its life depends almost entirely for its growth and development on the milk supply of its mother. The digestive system of the young lamb is not sufficiently developed to allow it to deal with harsh bulky foods.

It is, therefore, apparent that an adequate supply of highly nutritious food rich in flesh-forming and milk-producing material, *i.e.* protein, should be available to the ewe for the last four weeks of pregnancy and from the time the lambs are dropped until they are marketed.

In the case of the Merino, and lambs other than those for export, a steady rate of growth through the winter, followed by good natural feed conditions during the spring, is sufficient to ensure a well-grown weaner. With such lambs the short period of somewhat slow or retarded growth is counterbalanced by the accelerated later growth when the feed becomes plentiful in the spring. With the export lamb the position is different. Prime quality, showing good bloom and "finish," can only be ensured where the lamb is growing at a maximum rate throughout the whole period. Slow growth in the early life will be reflected adversely in the final product. An abundance of good feed is, therefore, of profound importance for the production of prime quality export lambs.

Supplementary Feeding.

Where farmers have mated so that lambs can be expected before the green feed arrives it is essential that provision be made for supplementary feeding. Concentrates, such as oats or peas, with good quality hay, or, better still, meadow hay made from Subterranean Clover pastures, should be supplied to the lambing ewes until a bulk of green feed is available.

Green Feed Crops.

Preparation should also be made for green crops such as oats, rape or barley, or mixtures of these crops. Well prepared fallow, preferably on the lighter soil types, will permit of areas of green feed crops being sown which will germinate and get away well after the first rains. Crops of this nature quite frequently make excellent growth and before sufficient rain has fallen to produce germination and growth on pastures.

Renovation and Top-Dressing of Pastures.

Good pastures, especially of the Subterranean Clover type, are excellent in supplying a highly nutritious protein diet so valuable for milk production. Every effort should be made to induce early germination and growth before the cold weather conditions have set in. Suitable soil renovation will produce a loose surface and allow the early rains to penetrate and so encourage early germination. Adequate top-dressing with superphosphate is also essential. This stimulation of the early growth of pastures is also valuable in strengthening them and preventing the serious effects of insect pests, such as lucerne flea and red mite. Pastures which germinate under cold winter conditions suffer much more from these pests.

Care and Attention at Lambing Time.

At lambing time special and frequent attention should be given to the ewes. They should preferably be pastured in paddocks containing shelter belts on high and dry conditions. Daily inspections should be made and, where required, attention given to those ewes experiencing lambing difficulties. If possible, at weekly intervals the ewes which have lambed, together with their lambs, should be worked off the flock and pastured separately on the best pastures or special crops. The lambs should be tailed and marked when two to three weeks old. This procedure

should be carried out at similar intervals throughout the season, so that no lambs become too old before being treated. If the lambs are too old and big they will suffer a setback following the operation.

Marketing.

The age and size at which to market the lambs always presents some difficulty to the farmer. The weight should not be the main consideration in deciding when to market. Of more importance is the quality and "finish." Large framed lambs may not be sufficiently "finished" at 30-32 lbs., and would consequently be graded second-grade. Such a lamb could probably be held for further time to advantage and grade first-grade. In general, conformation and "finish" should be the main guides in determining when to market. Marketing should be carried out at frequent intervals, as lambs after they reach their top are likely to go off and lose their bloom and "finish."

The most profitable weight at which to market the lamb is also a question which is open to much discussion. Frequently overseas reports indicate that the lamb most favoured is the light weight one. Careful examination of the returns from the Avondale Research Station have indicated that the 8's (37-42 lbs.) have realised 1s. to 1s. 6d. per head net at the works more than those in the 2's grade (29-36 lbs.). Those in the D grade (28 lbs. and under) have realised considerably less than the 2's and 8's. Moreover, in practice lambs which would dress in this grade (D) are generally not sufficiently "finished" to be marketed. The heavy grade 4's (43-50 lbs.) have generally realised about the same, to slightly less, than those in the 8 grade and indicate that it is not profitable to allow the lambs to reach this weight.

Whilst market fluctuations may cause a revision of this question in future years it would appear advisable to aim at a dressed weight of about 36 lbs. tending towards the heavier side but not above 42 lbs. Live weight figures on the farm for these dressed weights would be approximately 75-85 lbs.

Although it is not necessary to weigh all the lambs on the farm it is a good practice to weigh a few from time to time as the weights of some lambs are often very deceptive. Towards the end of the season it is often apparent that some lambs will not be ready for export before the grass seeds appear. Such lambs should be shorn and held for two or three weeks or more before marketing, when any skin or bruise blemishes which have occurred during shearing will have disappeared.

Young lambs are very tender and easily bruised and every care should be exercised when handling and trucking them so as to avoid this bruising, which results in lower grading and consequently reduced returns. Mr. Davenport, Agricultural Adviser, drew attention to this question in the issue of this Journal of June, 1937, and stated that "the most common causes of bruising were catching and picking up the lambs by the wool, hitting or prodding them with a stick or hard object; when drafting or loading allowing them to become overcrowded in a confined space as when passing through a race in the yards or into a truck; the use of a dog without a muzzle (a slight nip will leave a tell-tale bruise)." Avoid all these practices.

In conclusion it is not suggested that the adoption of these various points will bring the State's percentage of first-grade lambs up to a figure like 75 or 80. The question of suitable sires and the general absence of large numbers of crossbred ewes will mitigate against this at the present time. It is felt, however, that there is considerable room for improvement in the feeding, general care and management which, if adopted, can materially raise the level of the quality of the lambs exported from this State.

IRRIGATED PASTURE COMPETITION.

RESULT OF FIRST YEAR'S INSPECTION—1937.

A. R. C. CLIFTON,
Officer in Charge of Irrigation.

H. G. ELLIOTT,
Agricultural Adviser Dairy Branch.

The Competition was inaugurated by the Harvey Agricultural Society and embraces the whole of the irrigation areas extending from Waroona to Dardanup.

The object of the Competition was to stimulate interest and to demonstrate methods proved successful in the management of irrigated pastures, particularly the necessity for adequate drainage.

The Competition will be conducted for a period of three years and will be judged twice annually. Cuming Smith & Mt. Lyell Farmers Fertilisers Ltd. have generously donated a trophy valued at 10 guineas for the winner at the conclusion of the Competition. Each Agricultural Society also is awarding an annual prize for the winners in their area.

The results of the two inspections which were carried out during the months of June and December have been combined and the results of the first year's inspection are given in the following table:—

Competitor.	Drainage and Irrigation Lay-out and Condition. (20)	Mixture. (20)	Sward and Uniformity. (20)	Condition of Pasture According to Age. (20)	Management. (20)	Total. (100)
C. E. Edwards, Waterloo (1)	17	16½	16¾	18½	11½	80
E. Holthouse, Harvey (2)	12	17½	17¼	17	8¼	72
J. Salarian, Waroona (2)	13	16½	15½	14	11¾	70½
C. E. Edwards, Waterloo (2)	13½	15¾	15½	16	9¾	70
A. E. Jackson, Roelands	13½	16½	14¾	15	9½	68¾
L. Temple, Harvey (2)	13	16½	13¼	14¼	10¾	68
L. Temple, Harvey (1)	13	16½	13	14½	10¾	67½
T. P. Harris, Waterloo	11¾	15¼	14¾	14½	10	66¼
J. Salarian, Waroona (1)	10½	15	15½	13	10¾	64½
F. Reeves, Brunswick	11½	14½	13½	13	10	62
E. Holthouse, Harvey (1)	13½	16¾	11½	12½	6½	60½
S. Bowers, Brunswick	12	14	11¾	12	9¾	59½
T. Tyrell, Waterloo	11½	13½	11	9½	8	53¾
H. Piggott, Brunswick	10¾	13½	10	11½	7	52½
C. F. Giblett, Harvey	11½	14	10½	10½	6	52¼
L. and C. Hynes, Waterloo (2)	10½	13¾	10¼	9½	6	50
W. C. Edwards, Burekup	13½	10¾	9	8½	8	49¾
W. Noakes, Brunswick	9½	12¼	11	10	6½	49½
L. and C. Hynes, Waterloo (1)	11½	14	10½	9	4½	49
J. Hynes, Waterloo	8¾	13	10¾	10	5½	48
F. J. Beecher, Harvey	13	8¼	8	7½	8½	45¼

The winners of the annual prizes awarded by the Agricultural Societies conducting this competition are as follows:—

Brunswick Agricultural Society: Mr. C. E. Edwards, No. 1 entry.
Harvey Agricultural Society: Mr. E. Holthouse, No. 2 entry.
Waroona Agricultural Society: Mr. J. Salarian, No. 2 entry.

It is evident from the number of entries received that the settlers in these districts are keenly interested in the development of irrigated pastures. Generally, the pastures exhibited were good, some of them being capable of carrying approximately 1 cow to the acre. These results have been achieved only by careful attention to watering, manuring, and the judicious grazing of the pasture.

One of the most important features noted was the fact that good strains of pasture grass and clover seeds were used in every case.

Another important factor was that in many instances the mistake was made of laying down pastures too soon before the land was properly prepared. For an important crop like permanent pastures which, with proper management, will be reproductive for many years, it is obvious that thorough and very careful preparation is essential to obtain the best results. It is recognised, of course, that farmers generally have had very little time to fit their land properly for irrigation, and it is particularly interesting to note the successive improvements of individual farmers by comparing the layout of their initial irrigated pastures with the one sown at a much later date.

The general application of fertiliser per acre had a tendency to be on the low side. Some of the farmers, however, are applying up to 6 cwts. of fertiliser in two or three applications per annum. On an average 3 to 4 cwts. of superphosphate are being applied in two applications.

At the time of the first inspection it was noted that—

The general management was at fault in one or more of the following: Drainage, Irrigation (furrows too wide apart), Grazing, Fertilising and Renovation. Many entries indicated that more attention to drainage is essential if the productivity of the pasture is to be maintained. This condition is obviously more noticeable where the development is comparatively recent and farmers have concentrated on bringing their land under irrigation and have so far only provided an inadequate superficial system of drainage.

In some instances inadequate drainage is combined with poor pasture management, such as overgrazing, faulty technique in the application of water, and the excessive crowning of the lands between water furrows. Where such conditions prevail bare patches sometimes appear, more particularly along the crowns of the lands and towards the end of the irrigation season, in extreme cases, salt becomes sufficiently concentrated so as to be seen on the surface. Although these bare patches may be directly due to the accumulation of salt which is readily dispersed by the winter rains if drainage is provided, proper irrigation practice which necessitates a correction of the above mentioned faults is known to prevent its appearance.

The results of the first year's inspections showed that—

Generally, the pastures are not grazed efficiently, being rather over-grazed during the winter months and under-grazed during the spring months. This was evident by the bareness and opening of the pastures at the time when grass production is at its lowest ebb, and the tufting and seed head production of the paspalum during the period when peak production is taking place. More attention could be given to the topping off of the pastures with a mower during the periods of high production.

Insufficiency of renovation by means of scarifiers or pasture renovators was also very noticeable, and the lack of efficient harrowing to break up "cow pats" was evident to a marked extent.

The majority of the pastures exhibited consisted of paspalum and white clover with or without perennial rye grass. In some instances, however, cocksfoot had been incorporated. Subterranean clover was showing to some extent during the flush period.

Some of the pastures showed excellent growth and vigour and were comparatively well managed, while the layout indicated a considerable amount of work in preparing the land and making provision for irrigation.

The main objective in irrigating should be to apply the water uniformly and economically to the land. This means a thorough and careful preparation before seeding. It was not uncommon to note paddocks spoilt by a claypan or two or a slight depression which could have been simply graded prior to seeding, whereas this condition is the cause of trouble in waterlogging and excessive waste of water.

Very little alteration had been made between the two inspections with regard to the irrigation channels, furrows and drains.

The furrows vary from 4-10 chains in length, the distance apart being from 7½-21 feet, the average of the latter being 12 feet and the average length 7 chains.

The winning pasture exhibited by Mr. C. E. Edwards as his No 1 entry was sown at the end of November, 1936, on an old pasture paddock which consisted mainly of subterranean clover and annual minor grasses.

Prior to sowing, the land had been graded and ploughed flat with the result that the contour of the paddock was excellent. It is provided with watering furrows 7½ feet apart and 6 chains long, these furrows being connected to a head furrow parallel to the head ditch, enabling economical control of the watering. At the outlet ends the furrows were connected to a tail water furrow, formed parallel with the drain and connected to it at suitable points, thus reducing loss of water due to run-off when irrigating, and at the same time providing adequate winter drainage.

The paddock was well drained, being provided with a cut-off on the top end and an outlet drain on the bottom end, and although the latter could be deeper it was being well maintained. The extent of the area sown was 4 acres.

The mixture sown was certified perennial rye grass 5 lbs. per acre, paspalum 2 lbs. per acre, and certified New Zealand white clover 1½ lbs. per acre.

One bag of superphosphate per acre was used at seeding, and 1 bag per acre again in February and May.

During the summer, 1936-37, approximately four weeks elapsed between each watering. This season, however, the interval between watering is three weeks.

The early grazing was carried out with sheep, and dairy cattle were only allowed to graze on it between waterings when the surface was dry.

At the time of first inspection there was approximately a 95 per cent. cover consisting of about 80 per cent. white clover, the balance being perennial rye grass with a small amount of paspalum. Practically no weeds were evident but a little couch grass was noticeable. This undoubtedly was the best pasture for its age at the time of inspection.

The patches which were showing the least amount of cover were where the subsoil had been exposed due to heavy grading. It was noticeable, however, that a decided increase in cover had taken place during the short interval between the two inspections of these areas.

The pasture exhibited by Mr. T. P. Harris was originally sown with paspalum and white clover during 1935. At the time of first inspection, it was showing a considerable quantity of couch with a ground cover of approximately 90 per cent., it being rather badly grazed and showing the effects of excessive winter water.

More adequate drainage has been carried out and the area has been more efficiently fertilised. This plot showed the most marked improvement of any at the time of second inspection, when there was practically a full ground cover of

paspalum and white clover which had been grazed very well and the paspalum prevented from running to seed head.

An interesting feature on this property was an attempt to overcome the inadequate preparation prior to seeding by omitting the grading of the land. Pasture sods taken from a drain cut after seeding have been placed in a typical "clay pan" with the result that the depression has been completely filled and is producing a good mat of pasture. This is practically the only way of overcoming this type of defect after seeding, but it is much more costly than doing some grading prior to planting.

In some cases scalding of the pastures had occurred after the first watering, this being due to the lodging of the water too long in the irrigation furrows, more particularly where excessive ridging of the land had been adopted in the layout.

In one instance considerable damage had been caused to the pasture through not watering early enough. This reduced the area of grazing considerably, as there were large areas completely scorched off by the dry conditions.

NOTES ON THE LATE TALLAROOK STRAIN OF SUBTERRANEAN CLOVER.

H. G. Elliott,
Agricultural Adviser, Dairy Branch.

As the name indicates, this variety originated in Victoria and is classified as a late strain, having approximately the same growing season as the Wenigup or Western Australian late strain.

The Late Tallarook strain has relatively short primary runners, the plants form a dense, compact mat with a high proportion of leaf to stem. The plants tend to remain in the rosette stage much longer than any of the other strains and form their runners and flowers much later than the mid-season strains.

For the past two seasons it has been growing experimentally at the Denmark Research Station and Brunswick with outstanding results.

At the Denmark Research Station where Lucerne Flea and Red Mite infestation is particularly high, other varieties and strains of clovers, grasses and fodder plants were badly attacked, whereas the Late Tallarook strain was only slightly attacked. Similar results were obtained at Brunswick.

The following description of this strain may be of value. It has a pale green calyx and a white corolla, while the leaves are larger than the other types with white crescent and black flecks.

In the higher rainfall areas of this State, this variety should do particularly well on account of its lengthy period of green life, high production and seed formation, marked resistance to red mite and lucerne flea, and its reputed marked palatability.

The Department of Agriculture is conducting further trials with this and other strains of Subterranean Clover in various districts.

The Victorian Department of Agriculture is certifying the Late Tallarook strain of Subterranean Clover and the seed can be obtained commercially.

CARE IN CRUTCHING.

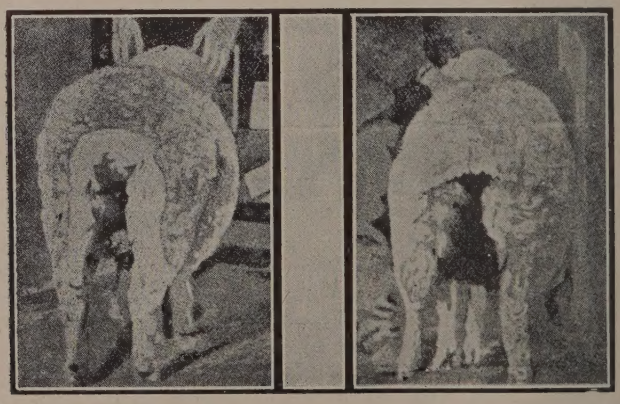
HUGH MCCALLUM,
Sheep and Wool Inspector.

One of the most efficient methods of combating the blowfly is to ensure good crutching. The discolouration about the hindquarters is due to accumulation of dirt in the long wool. This should be removed by crutching as it acts as an ideal breeding ground for the blowfly. Crutching should be done as often as necessary. A systematic mass crutching should be aimed at instead of dealing with an odd sheep in the paddock as is often the practice.

The actual operation should be started by clearing the wool from behind the udder and between the hind legs. This section is done with the sheep sitting on its haunches and having its back leaning against the closed legs of the shearer. For the next part, the sheep must be laid on one side and the wool removed from the back of the lower leg and just beneath the tail. The sheep is then turned on the other side and the opposite back leg is treated likewise.

It is advisable to take off a narrow strip of wool from just above the tail. The finished job, looked at from behind, takes the form of an inverted "U" running from hock to hock over the tail. It is wise to slope off the wool between the short and long parts and not leave a distinct ridge of overhanging wool to get wet and dirty and so attract more flies.

Great care should be taken of pregnant ewes which should, on no account, be carried from the pen. It is advisable to take the utmost care of them when going through gateways and when turning. When crutching there is no necessity to lean on the sheep with the knee or to press heavily on the flank with the fist. The ultimate results of handling ewes roughly are premature births, malformations and dead lambs.



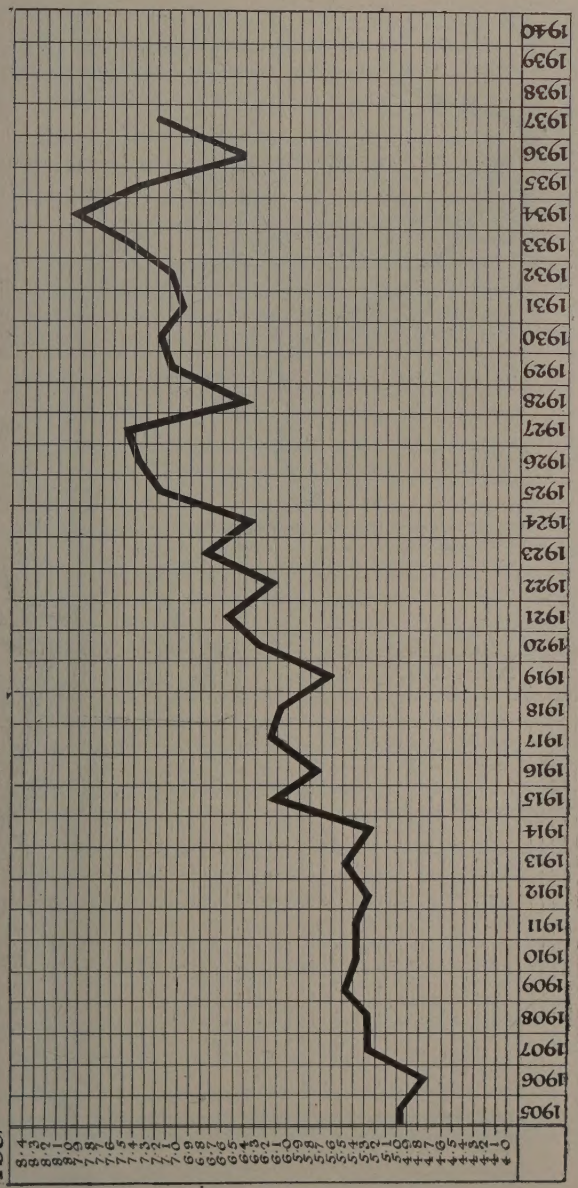
Correct method. Incorrect method.

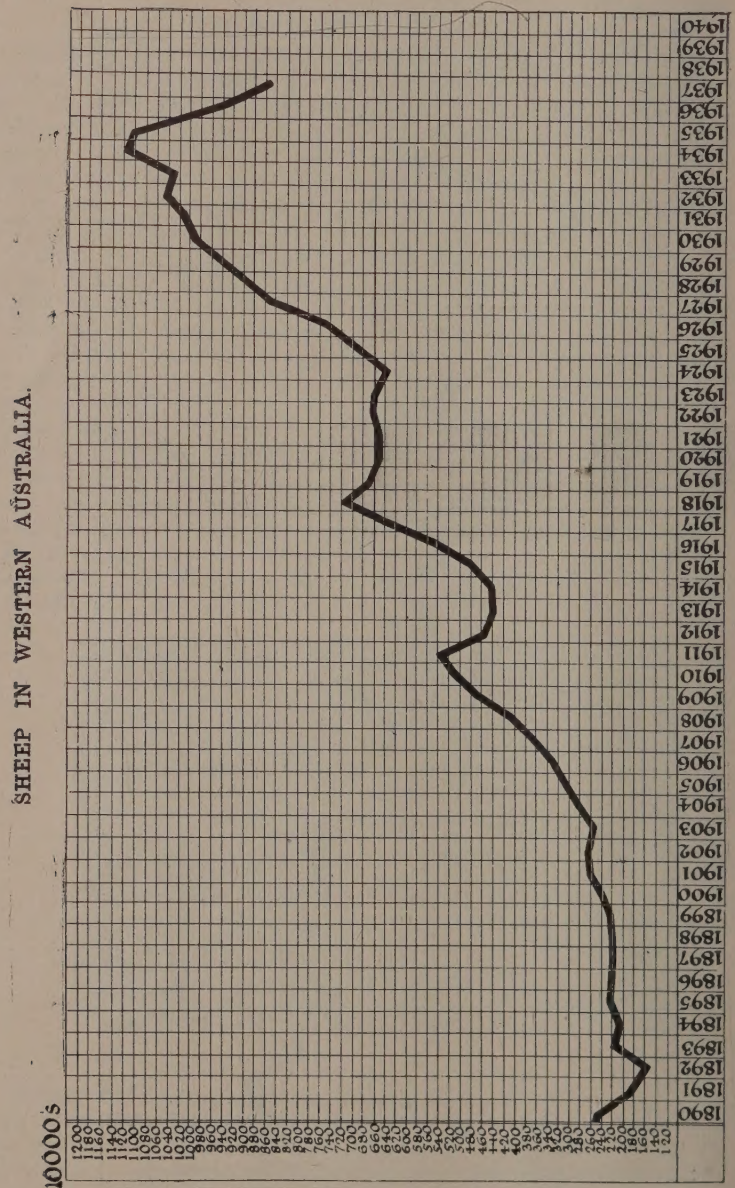
Many flock-owners crutch their high-grade ewes in a standing position, one person holding the sheep and another handling the shears. By this method there is no possibility of the lamb being turned—the standing position may be much slower but it is certainly the safest method under these circumstances.

Another benefit derived from crutching is the saving of wool. Through neglect of crutching sheep regularly and correctly a considerable poundage of good wool is wasted at shearing time on account of the large percentage which is stained.

Briefly, then, crutching helps against blowfly, saves wool and, though not previously mentioned, is an assistance to lambing and lamb feeding.

AVERAGE WEIGHT OF GREASY WOOL PER FLEECE.




SHEEP IN WESTERN AUSTRALIA.
10000's
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
960
940
920
900
880
860
840
820
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940

FOOT ROT IN SHEEP.

A. McK. Clark, L.V.Sc.,
Chief Veterinary Surgeon.

Foot rot in sheep and cattle has become particularly prevalent in the South-West portion of the State owing, firstly, to intense pasture development, and secondly, to the neglect on the part of the owners to recognise the disease in its early stages and adopt adequate control measures. This disease exists in all countries where pastures are luxuriant and land is moist. It does not cause great economic loss provided correct control measures are systematically exercised. The only loss in this direction is sustained through loss of condition in sheep and the cost of constant attention.

Foot rot can be recognised in its first stages by lameness. On closer examination a red discolouration of the skin occurs, particularly between the hoofs. Later there is a swelling of the affected tissue and an oozing of clear yellow fluid. An offensive odour develops and the hoof becomes soft, spread and turned upwards; that is, an extra growth of hoof occurs and it becomes, in consequence, spongy and malformed. Sheep may even be seen at this stage eating on the knees.

Prevention.—Although the disease may be termed infectious there is some predisposing influence which must be present. This is due apparently to moisture over a prolonged period as sheep in reasonably dry areas are not affected. In heavy rainfall areas Merino sheep should be avoided as this type is prone to foot rot. The English breeds should be introduced as these have a greater resistance to this infection than the Merino.

Treatment.—Early recognition of foot rot is the greatest advantage in control. When the disease is discovered in a flock all the sheep should be carefully examined and any showing lameness should be separated off from the rest. The former should be placed in a small paddock as constant attention is needed. Each should be closely examined and any loose horn cut away from the hoof and the hoof trimmed up generally. Having done this the sheep should then be placed in a foot bath solution. They should not be walked through quickly but held in the solution for about one hour. This treatment should be done several times at two day intervals. The portion of the flock in which no disease is apparent should be passed occasionally through this solution. It will be necessary, therefore, to construct a concrete foot bath. Foot rot cannot be successfully combated unless an adequate foot bath is used. This bath should be at least six inches deep, 12 inches wide and long enough to hold about fifty sheep. The bath should be filled to about three inches.

The Solution.—Bluestone is effective and cheap. Foot rot can be effectively controlled with this drug. Its use is recommended in a 5 per cent. solution; that is ½ lb. bluestone dissolved in 1 gallon of water. A stronger solution than this has a tendency to burn the tissues of the feet and cause extreme damage. Formalin is also efficacious in a 2 per cent. solution. The same may be said about this that a stronger solution than 2 per cent., apart from being expensive, may damage the feet.

It may be necessary in extreme cases to give individual treatment to affected animals. In such cases, after paring the feet, the hoof should be dressed with a solution composed of a mixture of picric acid 4 ounces, methylated spirits 1 gallon. Apply with a brush. Also another solution may be used composed of resin 2½ lbs. dissolved in 1 gallon of turpentine and then add ½ pint of monsol. Stir vigorously until a uniform mixture is obtained. Apply with a brush.

Should one desire to use formalin for the purpose of treatment it should be mixed with glycerine in the proportion of 1 pint of formalin in 9 parts of glycerine.

Cattle should be treated as recommended for sheep.

Consideration may be given to the use of canvas boots for sheep and cattle.

HATCH YOUR CHICKENS AT THE RIGHT TIME.

G. D. SHAW,
Poultry Adviser.

An important factor in profit earning is that of hatching the young pullets at the proper period. It is written in every possible poultry journal that chickens should be hatched so that they begin to lay when eggs are at their highest prices, but still we have chickens hatched from March to November! No stretch of imagination will envisage a pullet hatched in March beginning to lay when prices are highest, and the same applies to those hatched in November, but between these two extremes there must be some period when the pullets can be hatched to lay when prices start to rise and then continue laying for the 12 months following.

In the years before 1929 egg prices were distinctly on the rise in the middle of February, and although the intervening years have seen a later date for this rise, prices can be expected to revert to normal at any time. Even allowing for a slight spread of price levels, we have also the most successful hatching period to consider, and that period is naturally in the spring, which is Nature's time for reproducing its species. Any departure from spring hatching is obviously unnatural.

In Western Australia the spring hatching for successful rearing is from 20th July to the 31st August for heavy breeds, and from 1st August to the first week in September for light breeds—a period of approximately five weeks for each class of breed.

Any breeding activity outside those periods must tend to decrease profits and it will be agreed that the poultry industry must endeavour to obtain the greatest profit from the stock held, and that profit must be obtained in the shortest time possible. The business man never stocks winter goods to be held over a summer period: he stocks for the season of *quickest* returns. The aim of a good business man is to produce at the cheapest cost and sell in the dearest market. This should be the aim of the poultry industry.

Rear at the cheapest period in order to be able to sell in the dearest market. The two interlock. One cannot be called tedious if this point is stressed, but in stressing this aspect of poultry farming a new method of explanation is being propounded. Let us picture the activities of the average poultry farmer during the hatching period at present used in Western Australia, from June to October, and alas, sometimes into November. He is aiming to produce 400 laying White Leghorn pullets and he has sufficient incubators to produce this number when hatching from June to October.

The machines are set as follows:—

1. June 10th, hatching on July 1st.
2. July 2nd, hatching on July 23rd.
3. July 23rd, hatching on August 13th.
4. August 14th, hatching on September 4th.
5. September 5th, hatching on September 26th.
6. September 27th, hatching on October 17th.

In each setting he averages 120 pullet chicks, a total of 720 pullets during a period of 4½ months *hatching*, and they commence to lay as follows.—

Pullets hatched July 1st, commence to lay in January and moult in April-June.
Pullets hatched July 23rd, commence to lay in January, some (say 50) moult in April-June.

Pullets hatched August 13th, commence to lay in February and continue.
Pullets hatched September 4th, commence to lay in March and continue.
Pullets hatched September 27th, commence to lay in April, but only about half are laying.
Pullets hatched October 17th, should commence in May, but generally they are not in production until the fall in prices in June.

Taking account of deaths and culling, let us assume that 80 pullets have been reared from each batch. Now what happens? The first two hatchings, which have started to lay in January, will surely go into a neck moult or even a full moult when April or May comes round. In very few rare occasions do they continue to lay through the period April to June when eggs are dear. The next two hatchings, which start to lay in late February and March, will continue to lay right through the moulting period. The last two hatchings, born in late September and October, will not begin to lay by the time prices are high, and some are not even ready to lay when prices begin to decline, so we have—

Born July—80 moulting when eggs are dear.
Born late July—40 laying, 40 moulting when eggs are dear.
Born August-September—160 laying.
Born late September—40 laying, 40 not laying.
Born October—80 not laying.

The pullets are really divided into two classes when eggs are dear—240 laying and 240 not laying, being either moulting or too young. It must be remembered that the farmer still has his old hens which are moulting, and if he is a culler he will have 240 of these birds which are a drag on the profits of the pullets.

The farm now comprises:—

240 pullets laying.	240 pullets not laying. 240 hens in moult.
240 laying.	480 not laying.

Is it reasonable to expect 240 laying pullets to keep 480 non-layers for these three or four months? Yet such is what the industry expects.

Take farm 5, page 266, *Journal of Agriculture,* September 1937, with 550 pullets culled out to 370, all born in the one week and all laying when eggs were dear. Those 370 pullets laying 17 dozen marketable eggs per day at 1s. 7d. per dozen, average, over the 3L months could keep 240 moulting hens and return £4 as well. But if only 185 of those pullets are laying with 185 pullets not laying, together with 240 hens moulting, things take on another aspect; 185 pullets would have to provide feed for not only the farmer and his family but also for 185 pullets not laying and 240 hens in moult—425 not laying. On the same basis of production as these 370 pullets, 185 pullets laying 8½ dozen eggs daily at 1s. 7d. average could not carry the burden. They would not even be able to feed the flock and the farmer would then run into debt. By transferring the 185 loafing pullets into the laying class by hatching them at the right time, the proportions are entirely altered to 370 laying and 240 loafing. Then it does pay. How do we accomplish that change over?

This is done by reducing the period of hatching so that it will be confined to the two most seasonable months, those confined between the last week in July to 31st August for heavy breeds and 1st August to the first week in September for light breeds.

It will be realised that by shortening the season only two hatches at three weeks' interval can be obtained, but one can hatch greater numbers by augmenting the incubator's capacity.

What if the expense is another £20 for machines The farmer will not need any more kerosene, feed or eggs in order to do the work; the only expense is for

extra incubators, sufficient in number to hatch the total quantities referred to on page 12 in half the period. He will then have the whole of the 370 pullets laying when eggs are dear and only 240 hens moulting.

Let us now strike a balance with the extra £20 spent on new machines: with this advantage he will have another 185 birds laying 8½ dozen eggs a day at 1s. 7d. average, which is 13s. 6d. a day extra coming in; it will only take 30 days to recoup the £20 extra expenditure for incubators and for the next 2½ months an extra 13s. 6d. a day is a profit which can be used with satisfaction on the farm. The machines will then have been paid for and are ready for next year.

But if he will not spend that £20 more or less, he will be depriving himself of 13s. 6d. per day extra for 75 days—too great a loss to be tolerated by any thinking person. Our farmer will have all the breeders he requires for the 240 moulting hens, the balance of a well-culled flock, which have laid profitably right up to March 31 when he then decided to make them recondition. Of course all will not be fit for the breeding pen but there will be plenty of proved producers, and as the eggs are not wanted until July, and the moulting hens will have reconditioned, nearly all will be laying by then.

If he is a purchaser of chicks—one who does not desire to hatch his own—the problem is easy. He orders his chicks to be delivered during those few weeks. He orders early and pays a deposit in order to close the contract.

If one hatchery cannot supply at the date required he must go elsewhere. He must not let the hatchery dictate what dates he will be supplied.

It should be understood that the industry must go ahead. It cannot stand still, so the conditions of to-day are going to change. The hatchery must be prepared to respond to the demand of the purchaser. This will mean that hatcheries will have a shorter season with more machines. Their remedy is obvious. The industry cannot continue to keep 425 loafers on 185 layers and the transfer must be made before contentment arrives. The new conditions are going to demand that all sections of the industry respond or go out.

The old practice was to hatch sufficient young stock to replenish the outgoing due to the two-year old hens and the farmer had only sufficient pullets on the block to recoup for the outgoing in the moulting season in April to June. It was no uncommon sight to see the farm stocked with three-quarters of the birds not laying. Such a percentage of non-layers was a severe drawback and the farmer could not pay for his feed bill let alone have anything over for himself. His debits mounted up for the whole of the moulting period and he relied on the spring lay to recoup him for that debit. Needless to say, he was not very contented with the conditions of the industry.

The whole trouble has been that the farmer was not sufficiently alive to the culling of the unprofitable birds. He never gave a thought to the loss incurred when a bird ceased to produce sufficient eggs to not only pay for feed but also to return a little over for the farmer.

Culling is the basis of all the arguments for replenishing the young stock. If one does not cull there will be at least 80 per cent. of the pullets alive at the end of the first year, so the replenishment is not so big in proportion to the situation when the remainder is only 50 per cent. of the beginning of the year.

In the *Journal of Agriculture* for September, 1937, pages 265-278 appeared an article on "Culling the Flock." The economic factors are definite and the methods can be applied with confidence by any poultry farmer.

The article was for the beginner—the farmer with little experience. It placed before him a simplified method of detecting the "duds."

It has many times been suggested that culling must be performed in daylight. This is absurd—the night is equally satisfactory.

We have been told that the birds should not be disturbed at night, yet one cannot but suggest that night culling is not disturbing to any flock.

The night work is easy to both man and bird as the birds are not rushed over a shed, they are not driven into catching crates, and they are not handled at the period of greatest activity—daylight.

The farmer should always visit the fowl sheds after dinner. The practice is extremely valuable. The inspection which takes place then is thorough. The birds are used to handling for condition. Vermin are detected (they are never seen in daylight) and sickness, if present, is easily noticed. *What is easier than to lift off the perches those duds which show up prominently when scattered throughout a flock of good birds?* All birds being settled it is easier to detect the "dud." There is no fast movement of heads and legs. The "dud" only is handled; the remainder are not touched.

In fact, all birds enjoy handling after they are trained (which training should take place early in life). Have we not heard the contented happy talking of the properly handled bird?

Are the birds trained for showing any the worse because they are tame?

Handling at night is a pleasure for all and the birds like it.

These foregoing remarks are impressive—the farmer will find his culling a pleasure and a profit. It does not interfere with his daytime duties and it does not entail hard and trying work in driving and catching.

As only a few duds are detected at a time, culling is continuous and the profits at a maximum.

Now let us take the situation of an unculled flock in April with 800 birds going through the moult and only 1,000 pullets. If 500 of these pullets are hatched in the periods which will not guarantee their laying in April, if those 500 are also moulting or have not started to lay, we are going to have a flock of 1,300 loafers, with 500 hard workers trying to keep them in food, and the farmer can wait for his share, and he will have to wait a long time. Even if one does not cull an entirely different picture will be shown if the farmer has hatched those 1,000 all to lay at the correct time, *i.e.*, when eggs are high in price. One thousand pullets producing 400 eggs a day at 1s. 7d. doz. would be able to feed the moulters and give something over for the farmer. But if the farmer was a believer in the practice of culling the moment the bird ceased profitable production, the ratio would be in the vicinity of 800 pullets producing 400 eggs a day (the 1,000 pullets would have at least 20 per cent. taken out as not profitable birds), and only 500 odd old hens going through the moult.

The position is quite clear. First we must start to cull from the moment the chick is born and continue throughout the year. We must never let up on the practice. Our birds must never be allowed to stay on the block one day after we have noticed their poor laying, and we will then appreciate the other side of the picture. We must always estimate and endeavour to rear such that we will always have twice as many pullets coming into the lay the moment the hens are beginning to moult. To do this we must reduce the hatching season to a very short one. We do not want to be keeping not only the hens when in moult but also the pullets which are as yet not near the lay. The load is too heavy.

Some will hesitate to try the short breeding season, but they can be assured that the advantages are numerous.

Let us look at the idea from another angle. The nominal cost of rearing pullets to the laying stage, taking account of the cost of eggs, kerosene for incubat-

ing and brooding, feed—in fact every cost which can be legitimately charged against the pullet to laying stage—is in the vicinity of £25 per hundred of the good, well-culled pullets left. *This £25 is a debit against the pullets, and not against the old hens.* The pullets incur the debt, therefore they must pay that debt back. Their costs should not be a charge against the laying stock. The laying stock did not want them. If they all start laying between February and March, they will begin to recoup the debt with eggs at 1s. 7d. per dozen average, and in no time they will be debt free—about the end of June or middle of July. (Last year the flocks mentioned by me above had the debt recouped by the end of June, 1937.)

But if the flock of pullets do not start to lay until the prices decline, they are going to take longer to pay off the debt. It will take twice as long when egg prices have fallen to 10d. per dozen. You will now appreciate that the spread of the lay from January (when eggs are 1s. 3d.) to July (when eggs are 1s.) causes the debt to last longer and your profit is further off. When you have recouped yourself for the expenditure on the chickens, you will then begin to make a profit, and not before. So shorten the period of debt as much as possible by hatching the chickens out so that they will all begin to lay at the rise of prices. Do not spread the hatching and so miss the maximum profit.

Buyers of chicks may be perturbed because this practice of short hatching will have a tendency to cause the hatcher to place small eggs in the incubators, but one can be assured that the hatchery is not going to ruin a trade when it is dealing with the farmer who is aware of the economic side of culling and the profits attached to the proper breeding season. The clientele which demands the best chicks at the best time will always see that they obtain what is desired, and any hatchery which falls down on the order will be well condemned by the farmers. If the hatchery works on the best lines by culling, etc., it will always be in a position to supply chicks from well tried birds (those which have stood the test of time).

What of the hatchery? The manager will most likely be faced with the problem of completing his orders in half the time taken previously. The farmer will demand the chicks between mid July and early September and if the hatchery cannot supply will go elsewhere. This will force the hatchery to expand to keep his business, and the incubator capacity will have to be doubled, the machines will be idle for a longer period each year, the depreciation will be greater and the interest will still mount up, but the hatchery must meet these mounting costs. The costs will no doubt be recouped in other directions, but the farmer who is alive to the necessity of obtaining his stock at the correct time will cheerfully assist in the matter. Prices should be so arranged that there is no hardship on any section of the industry. If the hatchery cannot carry on owing to the mounting costs—the result of the increase in the number of machines required—the industry will suffer. Therefore there must be co-operation between the buyer and the seller of chicks. The seller must guarantee his wares and then the buyer will not cavil much about a slight increase in the price of day old pullets.

Any tendency towards cut-throat prices for day old chicks will be disastrous to both sections. The buyer of day olds must demand the best at the right time and then be prepared to recoup the seller for the extra expense entailed in producing the better class of stock.

When all is said and done what is a few pounds extra per thousand as a cost for guaranteed pullets, guaranteed both as to breeding, egg size, stamina, and as to the correct time of delivery.

Apart from the economic advantages of quick hatching there are others which although not directly connected with the £ s. d. of poultry farming, must have a very direct bearing in the long run.

First of all we will be breeding from hens, birds which have successfully progressed through a moult after having proved their laying capabilities over a year of profitable production. As there will not be any need for early eggs there will then be no need to have pullets in the breeding pens.

Secondly, we will not be "tired of looking after chicks." What a drag it is to have chickens on your hands from June to December. No wonder the late hatched never seem to thrive, and we always blame the lack of something the earlier ones obtained from the soil or season. That something might be inattention on the part of the attendant, because of his or her being "tired of the sight of them," and a very good logical reason it is when late hatched do no good.

Having referred to the economic advantages of hatching at the right time in order to catch the rising prices of eggs in the autumn, the matter of autumn-hatched chicks may well be discussed also.

If for any reason the spring hatch has been insufficient to meet the requirements of the farmer, it has been a practice in the past to increase the flocks by hatching several hundreds of chicks in the autumn—March to May. Many arguments are put forward as to the advantages of the practice, but as the basis of all the discussions in business ventures is costs and profits, the sooner the industry begins to think along these lines the better. Forget for the time being about the numbers to be stocked, and also forget about replenishments.

It has been mentioned previously that the newly hatched chicken, the moment it is born, has a debt against it. The hatching costs, which costs include the feeding of both the males and females of the breeding pens, and also the wasteage entailed because of the selection of those breeds, are an initial cost which is in most cases assumed, but to the initial cost we must also add the costs of brooding and weaning, such as fuel and other incidentals, and we also have the cost of feeding to the laying stage. These costs (based on the results of 1936/37) of raising one hundred good pullets, which had been well culled, were in the region of £25.

It can be seen, therefore, that if there are 400 good pullets left at six months, the costs are in the vicinity of £100, or 4s. per bird, and *such costs are a debit on the pullets only and not on the old hens.* In simpler language, those pullets have borrowed £100 from somewhere in order to pay for their rearing, and before they can be considered as returning a profit that cost or debit must be paid back—every penny of it, and the only means of payment is through the eggs laid, plus any sum received for the sale of further culling.

The cost of feeding a pullet for the year 1936/37 was 11s. per year, or in round figures, we can work on 2½d. per week. A finer figure does not matter when explaining the point under discussion (profit over debits). Using the average figures (net) received for all grades of eggs January to June, 1937, the average price received was 1s. 7d. per dozen, and using the conservative figure of 50 per cent. production or even three eggs per week, the return of the August and early September hatched bird will be ¼ dozen @ 1s. 7d. = 5d.; cost of feed, 2½d.; profit over feed, 2½d. Therefore, the bird will be paying off her debt at 2½d. per week, and as she has 4s. to wipe out, it will take her 20 weeks in order to recoup the farmer for the money he has already paid out on her upbringing.

Now let us take the pullet which is born in the autumn, say March or April or May, laying in the normal six months (starting to lay in August, September or October) we can assume she lays the same class and grade of eggs as her August or early September-hatched sister. She will lay at about the same rate, but for better illustrations let us give her an average of four eggs per week against the three eggs credited to her spring sisters.

The prices of all eggs during the months of spring, 1936, were as follows:—

	s.	d.
In September average price all grades was	0	10¾
In October " " "	1	0
In November " " "	0	11
In December " " "	0	11
In January " " "	1	1¼
In February " " "	1	1¼
In March " " "	1	2

On these prices the pullets will take more than three times as long in which to clear accounts, and at the period when they should be returning a profit there will surely be a general moult.

The following is a balance of costs and credits for pullets born in March and laying in September:—

	s.	d.					s.	d.
Sept.—Cost to maturity	4	0				Db. balance	4	0
Eggs laid Sept., 16 @ 10¾ ..	1	2½						
Feed cost, 4 weeks @ 2½d. ..	0	10½	profit	Sept.,	4½d.	debit	3	7½
Eggs laid Oct., 16 @ 1/-	1	4						
Feed costs, 4½ weeks at 2½d. ..	0	11½	profit	Oct.,	4½d.	debit	3	3
Eggs laid Nov., 16 @ 11d. ..	1	3						
Feed costs, 4½ weeks at 2½d. ..	0	11½	profit	Nov.,	3½d.	debit	2	11½
Eggs laid Dec., 16 @ 11d. ..	1	3						
Feed costs, 4½ weeks at 2½d. ..	0	11½	profit	Dec.,	3½d.	debit	2	8
Eggs laid Jan., 16 @ 1/1¼ ..	1	6						
Feed costs, 4½ weeks at 2½d. ..	0	11½	profit	Jan.,	6½d.	debit	2	1½
Eggs laid Feb., 16 @ 1/1¼ ..	1	6						
Feed costs, 4 weeks at 2½d. ..	0	10	profit	Feb.,	8d.	debit	1	5½
Eggs laid March, 16 @ 1/2 ..	1	7						
Feed costs, 4½ weeks at 2½d. ..	0	11½	profit	Mar.,	7½d.	debit	0	10
Eggs laid April, 16 @ 1/8 ..	2	3						
Feed costs, 4 weeks at 2½d. ...	0	10	profit	Apr.,	1/5	credit now	0	7

If the birds do not now go into the moult, they have been over seven months in the lay before they have returned a profit to the owner, but it is generally recognised that the autumn-hatched pullet will, in nine cases out of ten, go into the moult. Imagine the position when the flock does start to moult. We can assume the moult will be starting in February and continue to the end of June. Such being the case, we find that the pullets are just beginning to balance the ledger when they are moulting, and for the next three or four months will be again creating a further debit—that of the feed costs over those months of rest.

Therefore the autumn-hatched pullet is in the class which is a handicap until it has completed the moult.

Put another way: the spring-hatched pullets have liquidated their debt by the end of June or the middle of July, at which time they are 9 to 10 months old, and are returning a profit to the owner from July or August until they are marketed, whereas the autumn hatch have not liquidated their debt until near the end of April (that is, if they do not go into a moult in the meantime). It is safe to say that the autumn hatching of pullets is not a paying proposition under these conditions, and should never be practised when egg-production is the mainstay of the farmer's activities.

In comparing the spring-hatched pullet against the autumn-hatched, we can do it another way. The normal age of maturity being six months with the spring-hatched pullet, we have six months for growing and then 12 to 13 months of laying, of which three to four months' lay is required to recoup the debit. We then have the balance of nine months' profitable lay before the pullet is 18 months old, and then the three months' moult.

But with the autumn-hatched pullet we still have six months' growing, with six months' lay, none of which shows a profit, and then we have the three months' moult.

In July both classes lay again, and continue for the following nine months. The comparison is then as follows:—

Born Sept. 1.	Born March 1 next autumn.
6 months growing.	
3 months laying to recoup.	6 months growing.
9 months profitable laying.	6 months laying to recoup.
3 months moult.	3 months moult.
3 months to recoup cost of feed during moult.	3 months to recoup cost of feed during moult.
6 months profitable laying.	6 months profitable laying.
30 months.	24 months.

This shows that in the September-hatched pullet we have 15 months' profitable lay during a life of 30 months, or to the second moult, but the autumn-hatched pullet gives us only six months' profitable lay in a life of 24 months, or to the second moult.

We have had no advantage by augmenting our spring-hatched chickens with autumn hatches. It would have been more profitable to have done without the autumn-hatched and concentrated for greater numbers during the following spring season.

To hark back a little: It must be agreed that the sooner the pullet pays off the debt of rearing the sooner the farmer will be able to reap the profits from his flock; therefore, care must be taken to see the hatching is completed in the correct period. It must also be realised that the price factor has a marked bearing on the subject. If the egg prices begin to rise to fairly high levels during the January and February of the year, the pullets will be able to recoup the debt sooner, and it also allows of a slightly longer hatching period, inasmuch as the hatching can be started a little sooner than would be practicable if prices were very low during those months, making sure we do not start too early—we must beware of the early pullets and their going into a moult. Of course, were the prices to rise early in the summer—in December for instance—the sooner the autumn-hatched pullet would liquidate its debt.

The matter of profit should be in front of the poultry farmer at all times, and a keen analysis of all factors will be the only way he will be able to solve what is now a very controversial subject. But we must not forget the principle that *all chicks create a debit,* and before they can return a profit to the farmer *the debit must be wiped out.*

ERRATA.

Journal of Agriculture, March, 1937, p. 19, "Royal and District Agricultural Societies' 50 acre Crop Competition, 1936": The rainfalls for Nyabing and Hyden Rock should read as follow:—

					Growing Period.									Total for Year.
	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	
Nyabing	94	14	10	67	213	349	79	181	74	17	913	42	54	1,194
Hyden Rock	36	14	18	22	131	241	105	193	63	12	745	25	80	940

Journal of Agriculture, December, 1937, p. 382: "The Control of Toxic Paralysis (Botulism) in Sheep and Cattle." In the twenty-second line of third paragraph "5gm" should read "50gm."

FERTILISER—ADDITIONAL REGISTRATIONS.

The last December issue of this Journal contains a list of the fertilisers registered for the current fertiliser year, together with the minimum percentages of the fertilising ingredients. Additional registrations, with the respective analyses, are shown in the following table:—

Name of Fertiliser.	Reg. No.	Brand.	By Whom Registered.	Nitrogen (N) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O) as		Cash Price per ton on Rails, Perth.
				Nitrate.	Ammonia.	Blood and Bone.	Bonedust.	Water Sol.	Citrate.	Acid Sol.	Total.	Sulphate.	Muriate.	
				%	%	%	%	%	%	%	%	%	%	£ s. d.
Blood and Bone	138	Cockbills	Harold & Murray	....	....	5·25	....	....	3·0	9·0	12·0	....	....	10 10 0
Nitrate of Soda	139	Champion	A. Hicks	16·0	....	....	....	....	....	....	....	....	....	*
Blood and Bone	140	B P B	do.	....	....	5·0	....	....	10·0	5·0	15·0	....	....	9 0 0
Do.	141	K.B.M.	R. Bates, Kalgoorlie	....	....	5·0	....	....	....	....	9·0	....	....	8 10 0
Bonedust	142	do.	do. do.	....	....	....	3·0	....	....	....	18·0	....	....	6 15 0
Animal Fertiliser	143	State Abattoirs, Midland Junction	State Abattoirs, Midland Junction	....	....	8·0	....	....	....	5·0	5·0	....	....	10 0 0†

* Price on application. † Price at works.

THE PAPAW OR PAPAYA.

(*Carica papaya.*)

G. B. BARNETT,
Tropical Adviser, Department of Agriculture.

With frequent inquiries being made as to the method of propagation and with an increasing demand for this fruit in the metropolitan markets, it is felt the following notes will be of interest.

It is not the intention of the writer to convey to Gascoyne River settlers that the time is opportune for the establishing of any large commercial areas, but there are sufficient indications to warrant the consideration by settlers of the planting of a few "trees" as a profitable sideline to banana growing. Without entailing much additional time, water or other costs, they could be grown in such positions as along the irrigation drains, on the headlands, between the outside banana rows and the wind breaks, between the young fruit trees or in the pineapple beds. Prices in the past for this fruit have been encouraging despite the fact that little or no attention has been paid by settlers as regards type, quality or condition of fruit being sent to markets. True though it is that the demand is greater than the supply, considerable caution must be taken with the amount of supply owing to the peculiar nature of this and many other tropical fruits, a liking for which is an acquired taste.

The papaw or papaya (erroneously called paw paw by many in this State and which is an entirely different type of plant indigenous to the Central U.S.A.) is a typical tropical plant and is a native of tropical America. It has proven itself quite suitable to Gascoyne conditions providing that normal care and attention are paid to cultural methods, and thrives best in a soil rich in organic matter possessing good drainage, in a sunny position free from frosts and boisterous winds.

THE PLANT.

This is a fast growing herbaceous plant possessing usually an erect trunk attaining a height of 10 to 25 feet, which is fleshy and hollow. The leaves, which are large, sometimes 2 feet across, are dark green and are produced in clusters at the top of the plant on hollow, smooth stiff stalks. This growth is erect in the early stages of development but later as the leaf stalks grow, they bend outwards and then downwards, giving the plant a palm-like effect. The life of a leaf varies from 4-6 months and at the axils or union of the leaf stalk and trunk the flowers are produced.

THE FLOWERS—MALE AND FEMALE.

The papaw is normally dioecious, *i.e.*, with the staminate or male and pistillate or female flowers produced on different plants. In addition to the staminate and pistillate forms, intermediate forms have been observed in which flowers of each sex occur in one plant. Staminate flowers may occur with rudimentary stigmas and ovaries which give rise to small worthless fruit and there is a hermaphrodite or bi-sexual type which regularly produces perfect flowers, is self-pollinated and yields excellent fruit. (While fruit of the staminate tree have been described as worthless there are instances of large and good-flavoured fruit having been produced but possessing thin skin and soft flesh which make them unfit for transport to market.) In the dioecious type the staminate or male plant (Figs. 1 and 2) the flowers are white, about an inch long and are born in clusters on long pendant

racemes sometimes 5 or 6 feet long, while the pistillate or female plant produces creamy yellow flowers about 2 inches long close to the trunk of the plant on short thick stalks from half an inch to 2 inches in length (Figs. 3 and 4). Both types of flowers emit a very pleasant scent.

It appears that nature holds the determining of the papaw sex as a close secret for although many and varied are the suggestions that have been expounded concerning the determination of sex in the early stages of growth of the plant, the

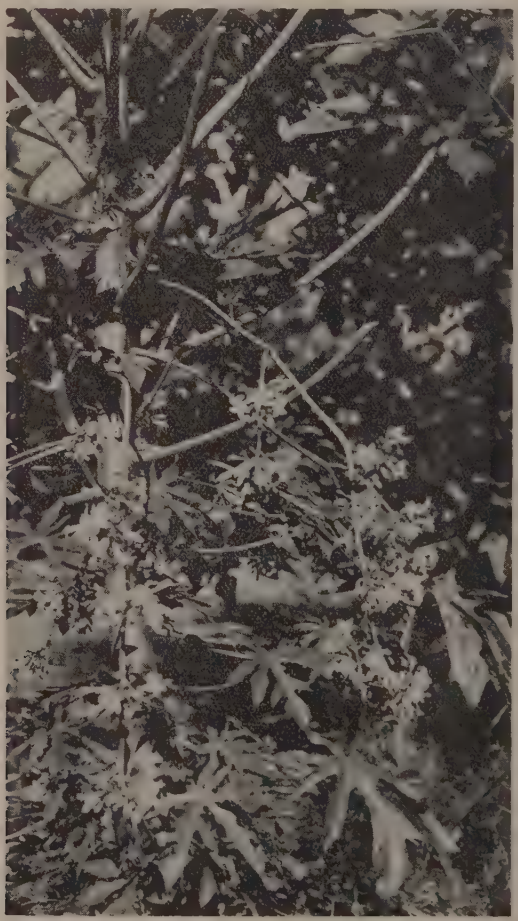


Fig. 1.—Staminate flowers on the papaw plant.

writer has yet to be convinced that any of the so-called "positive tests" are reliable except that the more vigorous plants in the nursery may possess a greater percentage of female plants. This line of selection is desirable apart from the viewpoint of sex, in that the most vigorous plants are the quickest to flower, thus maturing an early crop and such crop is usually born low on the plant which facilitates harvesting.

THE FRUIT.

The shape of the fruit varies from oblong to round, depending not only on type or variety. Soil, season, climate and cultural conditions seem to have considerable bearing on shape. The fruit when first developed are creamy white, but quickly take on a dark green colour. The weight varies from 1-10 lbs. when mature. When ripe the skin is smooth, thin and usually of a yellow to deep orange colour, while

Fig. 2.—Flowering habit of the male tree.

some types are pale green and are not considered very favourably by the trade. The flesh is of firm butter texture and possesses a yellow to orange-yellow colour. In the centre of the fruit is a fairly large cavity where are carried numerous round or oblong-shaped black seeds. The thickness of the meat or flesh varies from half an inch to two inches.

METHODS OF PROPAGATION.

The papaw may be propagated from cuttings, by grafts or seed, the latter being the commonest and to date most satisfactory method.

Cuttings are most successfully rooted when small limbs are removed from plants and care is taken to see that the natural swollen growth at the union of the small limb and parent plant is attached to the cutting.

Although this plant can be grafted successfully, there is little to be gained from this method of propagation for it has been observed that the parental qualities are not always retained except that the age of the parent seems to be transmitted in the scion. These facts appear to be present to the same degree in rooted cuttings.

SELECTION.

As already mentioned the propagation by seed is the best method. Little attention has been paid in the past on the Gascoyne in the matter of selection, with the result that many worthless strains are in evidence which are not only unremunerative but are a menace to the better types growing in the same vicinity.

Seed should be selected from a fully ripe fruit and from a tree known to be of a healthy, robust, heavy bearing nature. The fruit should possess a thick leathery highly coloured skin, a flesh of firm texture and good thickness. The shape, if possible, should be oblong, as this appears to be favoured by the trade, and a medium sized fruit is the most popular. Fruit with a very prominent nipple at the calyx end should be avoided as this tends to ripen earlier than the main body of the fruit and is subject to bruising, thus detracting from its value when presented to the buyer.

THE SEED BED.

Seed may be raised either in beds or boxes which contain a good rich sandy loam. The seed should be planted soon after being removed from the ripe fruit but seed will retain a high percentage of germination for twelve months if washed after removal from the fruit and kept in an airtight jar in a cool place. The best time for raising seedlings is during the spring months—September-December. The seed should be planted in rows about 12 inches apart with 2-3 inches between seeds and covered with about half an inch of soil. The seedlings should be above ground in 2-3 weeks after planting in the spring. Thinning the seedlings out to 6-8 inches will encourage good sturdy growth. The soil should be kept only moist as excessive watering may cause damping off. If the seed beds are in sunny positions the seedlings should be ready for removal to their permanent positions in two months from planting of seed when the seedlings should be 6-8 inches high (Fig. 6).

PLANTING OUT.

Several hours prior to transplanting, the seed beds or boxes should receive a liberal watering, and planting out should be done in the cool of the day. After selecting the most robust and vigorous plants, every care should be taken to avoid destroying the roots or the drying out of roots during transplanting. A thorough watering is advisable as soon after planting as possible, and once the plants show signs of being established, weekly irrigations should be sufficient. If planting out large seedlings, it is advisable to remove the majority of the leaves several days prior to planting, leaving portion of the petiole or leaf stalk attached to the plant.

Owing to the impossibility of determining the sex of the seedlings prior to flowering, it is advisable to adopt close planting and planting in pairs about 18-24 inches apart, allowing 3-4 feet between pairs, is suggested (Fig. 7). The thinning out of males, which usually predominate, should be done as soon as detected, and they should be cut up and dug into the soil as they are a valuable manure for the

remaining plants. No definite advice can be given as to how many males should be left as position of the plants has a considerable bearing on the matter, but as a guide 3 or 4 robust males should be satisfactory if well dispersed amongst 29 to 30 females.

While most plants have the tendency to develop the one upright stem, there are some that will develop lateral limbs early in life, which is very desirable as the plant then tends towards a low type growth carrying a larger crop of medium sized

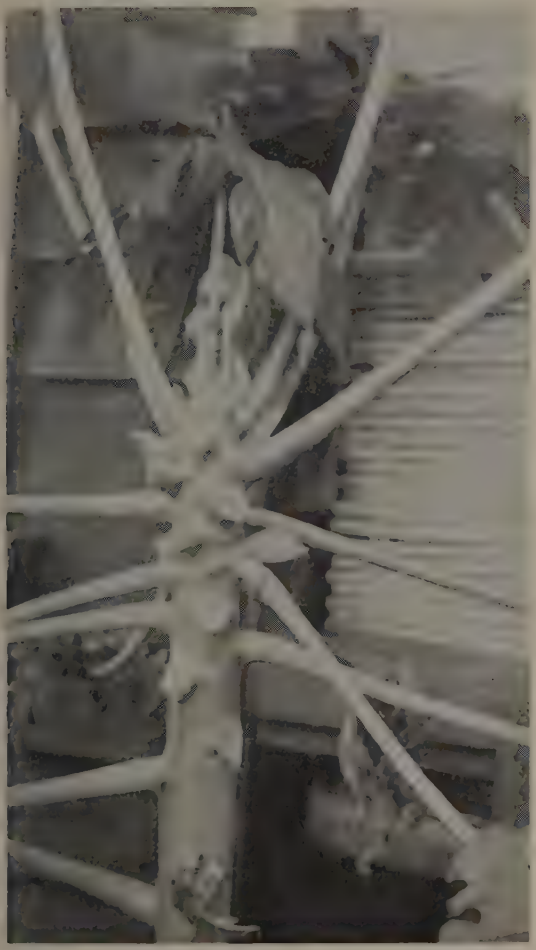


Fig. 3.—Flowering and fruiting habit of female tree.

fruit low to the ground. To encourage the branching type habit, the terminal growth may be nipped out when the plant is 3.5 feet high, but even this does not always force out the side vegetation. Some growers wait until the first main crop has set before removing the terminal growth when the branching habit can usually be obtained.

While plants may live for 10 or more years, it is usually found that after the second or third year the plant has produced its best commercial crops.

The plant readily responds to soil cultivation and liberal supplies of well-rotted organic matter, and will benefit from an application of Wyndham meat works manure whenever manuring the bananas, bearing in mind that if the plant is kept producing vegetative growth, there will be a constant cropping of fruit.

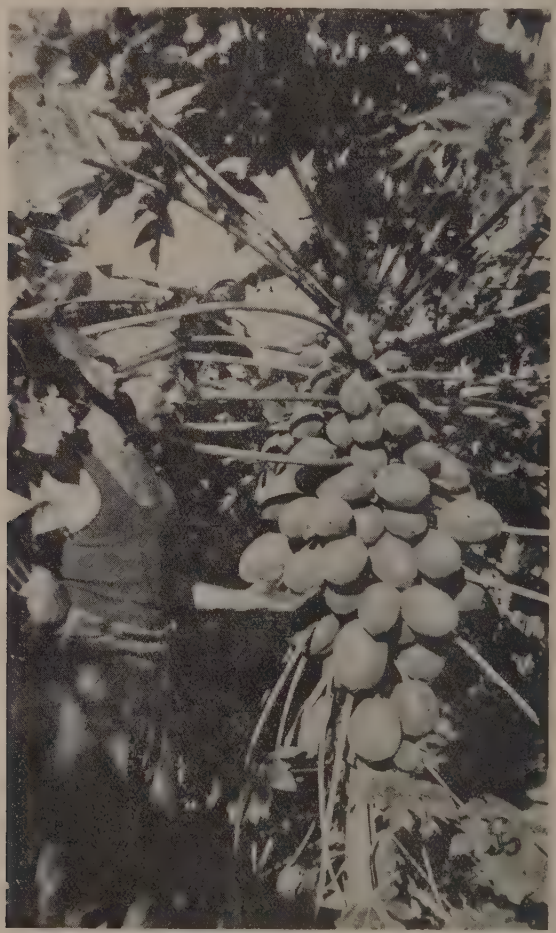


Fig. 4.—Eight months old pistillate or female flowering papaw tree.

HARVESTING AND HANDLING.

Like most fruits the papaw attains its best flavour if allowed to remain on the plant until ripe, but this is not practicable if fruit is to arrive at Perth markets in good condition. The stage to harvest for metropolitan markets will vary with the season. During the winter months it is possible to allow the fruit to remain on the trees until a fair amount of colour is showing, but in the summer it is necessary to harvest as soon as the yellow colour commences to show on the fruit.

Harvesting should be done during the cool of the day by holding the fruit firmly and giving it a slight twist, when it should come away with portion of the fruit stalk attached. The fruit should be handled with the greatest of care as it is very easily bruised and marked; even the slightest marking at harvesting becomes very pronounced when the fruit is ripe. If possible, the fruit should be allowed to sweat in a cool place for about 12 hours prior to packing. The fruit may be packed in the standard tropical fruit case (24¾ inches by 12 inches by 12 inches, inside

Fig. 5.—Bearing habit of male tree.

measurement), or during times of high prices the ¾ flat is more desirable. A layer of wood wool, dry straw or crumpled paper should be placed in the bottom of the case, and each fruit should be liberally wrapped in paper before being placed in the case, making sure that a padding of the paper covers the stem end of the fruit. The fruit may be packed either erect or lengthwise along the case. Never place the fruit across the case, for after lidding the case always travels on its side and fruit so packed are liable to receive damage to the stem or calyx ends. When packed the fruit should be slightly higher than the side of the case, and a liberal layer of wood

wool or crumpled paper should be placed over the fruit before lidding. The use of dead banana leaves as padding material is not to be encouraged for it not only detracts from the "get up" of the product but produces an unpleasant musty odour to the packed article. Use even grade fruit as far as possible, and upon the end of the case mention the count or number of fruit in the case.

USING THE FRUIT.

The most popular method of using the fruit is by cutting it in halves or slices lengthwise, removing the seed and to suit the taste, sprinkling sugar, salt, pepper, orange or lemon juice over it. Served in this manner it is a very popular breakfast dish. Some people prefer a few of the seeds to be served with the fruit as they have a flavour similar to water cress and are claimed to possess great digestive properties. This fruit is becoming increasingly popular in cafes when served with ice cream. Cut in halves with the seed removed, and port wine added, it makes a delicious sweet for the menu.

Fig. 6.—Papaw seedlings in the seed bed and at a suitable stage for transplanting.

Great medicinal properties are claimed for the fruit and plant from which is procured a milk-like fluid which when dried to a white powder contains "papain" and is used in the manufacturing of special digestive foods and chewing gum. The papain is harvested by making slight incisions in the skin of the fruit and the exuding fluid is collected in small vessels and then dried and ground to a powder. One authority claims that to extract 1½ lbs. of papain approximately 1,500 average size fruit are required to be treated.

PESTS AND DISEASES.

The plant is comparatively free from pests and diseases in Western Australia. Slight infestations of Red Spider have been recorded. The major loss of fruit appears to be from sun scald and slight fungus attack in the form of a rot which develops at the calyx end and exposed side of the fruit. The orange-piercing moth also does slight damage during drought periods.

REASONS FOR CROP FAILURES.

Crop failure, or fruit developing towards maturity and then falling from the plant, may be the result of blossoms being attacked by insects or disease, or unfavourable soil or climatic conditions at fruit setting stage. Excessive watering or manuring at this stage can also cause trouble, but where these conditions do not

Fig. 7.—Young papaw block. Note spacing of plants.

prevail it is quite possible that pollination is at fault. The shrivelling and dropping of fruit from the male tree is common, and if an inspection is made of the interior of the fruit, it will be found that the seed is undeveloped. Infertile fruit is usually insipid in flavour and the flesh is thin and leathery.

THE COST OF FEEDING PURE BRED COWS UNDER THE AUSTRALIAN OFFICIAL HERD RECORDING SCHEME, WESTERN AUSTRALIA, 1936-7.

By Officers of Dairy Branch.

In this article the cost of feeding pure bred cows during the period July 1st, 1936, to June 30th, 1937, has been computed on a similar basis to that adopted during the past five years, and the comparative value of the 25 herds assessed as producers of butter fat and milk.

Table 1 sets out the prices used in arriving at these costs, but, whilst each price is believed to be a fair average throughout the year, in individual cases a variation may occur, particularly in the case of home grown fodders. In general, values of the main concentrates are higher this year than last, but are offset by the fact that more farmers are realising the value of home grown crops and conserved fodder.

TABLE I.

PRICES USED IN VALUATING THE FOODSTUFFS CONSUMED DURING THE YEAR ENDED 30th JUNE, 1937.

	£ s. d.
Chaff, per ton	5 6 9
Wheat (crushed), per bushel	0 3 6
Oats (crushed), per bushel	0 2 7
Bran, per bushel	0 1 6
Pollard, per bushel	0 1 6
Silage, per ton	0 10 0
Meggitt's Meal, per ton	14 0 0
Proteena, per ton	12 0 0
Cowmeal, per ton	11 12 0
Keymeal, per ton	12 0 0
Brewer's Grains, per bushel	0 0 6
Green Lucerne, per ton	1 0 0
Green Maize, Sudan Grass, and Cereal Crops—	
Chaffed, per ton	0 15 0
Grazed, per head per week	0 2 6
Meadow Hay, per ton	3 0 0
Pasture, per head per week—	
Good, green	0 2 6
Dry	0 1 6

Table 2 shows the average results over the past 14 years.

TABLE II.

PURE-BRED COWS UNDER OFFICIAL TEST—AVERAGE RESULTS OVER A PERIOD OF 14 YEARS.

Year ended 30th June.	Average Milk Yield per Cow.	Average Butter Fat per Cow.	Average Cost of Feed per Cow.	Average Cost of Feed to Produce 1lb. Butter Fat.	Average Cost of Feed to Produce 1 gallon Milk.	Average Price, Butter Fat per lb.
	galls.	lbs.	£ s. d.	pence.	pence.	pence.
1924	600	319.50	10 4 10	7.70	4.09	19.5
1925	652	308.59	14 13 2	10.77	6.15	17.5
1926	624	312.01	14 14 7	11.15	5.66	19.0
1927	602	290.72	14 10 5	12.00	5.79	19.0
1928	592	280.56	15 11 4	13.34	6.34	19.5
1929	629	295.10	15 1 0	12.24	5.74	20.0
1930	636	294.98	14 10 3	12.74	5.10	19.5
1931	643	301.60	9 14 7	7.74	3.64	16.0
1932	696	318.96	10 18 3	8.21	3.76	14.0
1933	664	308.60	9 2 3	7.08	3.29	11.0
1934	720	333.70	10 2 6	7.28	3.37	10.0
1935	682	326.61	9 18 0	7.34	3.49	12.5
1936	681	320.14	8 14 7	6.54	3.08	12.5
1937	685	309.31	11 5 1	8.73	3.94	14.5

The low production costs shown by the Jersey herds in Table 3 are due mainly to the fact that nearly all these herds are in the wetter portions of the State, and, with one exception, are producers of butter fat only. This means that the cows come into profit in April or May, thus having the benefit of the longest possible period on natural green feed.

Amongst the Guernsey and Australian Illawarra Shorthorn herds, however, are several whole milk producers, and, as it is necessary for their owners to maintain a regular supply of market milk throughout the year, they sacrifice portion of their efficiency in being unable to bring in all their cows during the autumn.

TABLE III.

BREEDS COMPARED AS PRODUCERS OF MILK AND BUTTER FAT.

Breed.	Average Yield of Milk per Cow during 9 months.	Average Test.	Average Yield of Butter Fat per Cow during 9 months.	Average Cost of Feed per Cow.	Average Cost of Feed to Produce 1 gallon Milk.	Average Cost of Feed to Produce 1lb. Butter Fat
	lb.		lb.	£ s. d.	pence.	pence.
Guernsey (5 herds) ...	6,220	5.14	319.87	11 11 6	4.47	8.68
A.I.S. (11 herds) ...	7,674	4.03	309.61	13 9 9	4.22	10.46
Jersey (9 herds) ...	5,713	5.31	303.12	6 11 9	2.77	5.25

The great influence of climatic conditions is well illustrated in Table 4, which compares herds from "Wet" and "Dry" areas. Although average production is approximately the same, the costs in the "Dry" areas are double those in the "Wet" areas, which indicates the necessity for succulent conserved fodder and pasture establishment, together with controlled grazing wherever possible.

TABLE IV.

COST IN LIGHT RAINFALL AREAS COMPARED WITH THE SOUTH-WEST.

Average.	Production.		Cost of Feed for—	
	Milk.	Butter Fat.	1 Gallon Milk.	1lb. Butter Fat.
	lb.	lb.	pence.	pence.
Dry Areas (13 herds) ...	7,149	307.17	4.71	10.97
Wet Areas (12 herds) ...	6,326	310.93	2.44	4.98

The main Table, shown below, gives a very wide range of results and is arranged in order of merit according to profitable production of butter fat. Mr. P. G. Hampshire, of Yarloop, is to be congratulated on securing first place in this table with his Guernsey herd, figures which indicate excellent judgment in feeding for maximum production.

Although these cows were well fed, home-grown maize and clover hay, together with grazing on well-managed pastures, has kept the cost of feeding well below the average.

It will be noted that Mr. Hampshire's herd did not secure the highest butter fat average, nor was his cost of production per lb. the lowest on the list, but, by feeding judiciously for maximum output, without over-feeding, his herd showed the excellent return of £16 13s. 7d. per cow.

The figures for one herd in particular, *i.e.*, Herd "B," on this list indicate that the cows were underfed, and, although the cost per lb. was extremely low, the production of butter fat was 48 lbs. lower than the average, and the available skim milk 1,400 lbs. lower.

Results which deserve special mention are those achieved by Herd "Z" owned by Mr. W. G. Burges. Although this farm receives only 18 inches of rain per annum, full advantage is taken of the wet months to conserve fodder in the form of silage. This, together with lucerne and excellent cereal grazing, formed the major portion of the cows' diet.

TABLE V.

HERDS IN ORDER OF MERIT AS PROFITABLE BUTTER-FAT PRODUCERS.

Place.	Herd.	District—W = Wet, D = Dry.	Breed.	Average Butter Fat per Cow for 9 months.	Available Skim Milk per Cow.	Value of Butter Fat at 14½d. per lb.	Value of Skim Milk at 1d. per gallon.	Gross Return from Butter Fat and Skim Milk.	Cost of Feed per Cow for 9 months.	Profit per Cow.	Cost of Feed to produce 1 lb. Butter Fat.
				lb.	lb.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	pence.
1	D	W	Guernsey	367.65	4,742	22 4 1	1 19 6	24 3 7	7 10 0	16 13 7	4.89
2	W	W	Jersey	346.22	4,217	20 18 1	1 15 3	22 13 4	6 9 3	16 4 1	4.48
3	Z	D	A.I.S.	391.68	7,032	23 13 4	2 18 7	26 11 11	11 14 11	14 17 0	7.19
4	S	W	Jersey	318.64	3,674	19 4 11	1 10 7	20 15 6	6 6 5	14 9 1	4.70
5	B	W	do.	261.43	3,015	15 16 0	1 5 2	17 1 2	2 16 7	14 4 7	2.59
6	AC	W	A.I.S.	307.89	5,453	18 11 9	2 5 5	20 17 2	6 19 3	13 17 11	5.42
7	T	W	do.	271.52	4,747	16 8 0	1 19 7	18 7 7	4 19 9	13 7 10	4.41
8	H	W	Jersey	317.69	3,126	18 3 8	1 6 1	19 9 9	6 6 1	13 3 8	4.76
9	K	W	do.	275.13	3,416	16 12 3	1 8 6	18 0 9	5 7 3	12 13 6	4.68
10	I	D	do.	332.71	3,806	20 1 11	1 11 9	21 13 8	9 0 4	12 13 4	6.50
11	U	W	Guernsey	281.04	3,221	16 19 7	1 6 10	18 6 5	5 13 8	12 12 11	4.85
12	E	W	Jersey	281.88	3,272	17 0 4	1 7 3	18 0 7	6 4 8	11 15 11	5.31
13	Y	W	do.	253.99	2,143	15 6 11	0 17 10	16 4 9	4 10 1	11 14 8	4.26
14	AA	D	A.I.S.	327.33	5,627	19 15 6	2 6 11	22 2 5	10 9 0	11 13 5	7.67
15	M	D	Guernsey	381.78	4,330	23 1 2	1 16 1	24 17 3	14 15 9	10 1 6	9.29
16	L	D	Jersey	405.54	4,262	24 10 0	1 15 6	26 5 6	16 17 4	9 8 2	9.97
17	AB	D	A.I.S.	247.01	5,460	14 18 5	2 5 6	17 3 11	8 6 11	8 17 0	8.11
18	R	W	Guernsey	288.63	3,283	17 8 9	1 7 4	18 16 1	10 7 9	8 8 4	8.63
19	V	D	A.I.S.	315.00	5,424	19 0 7	2 5 2	21 5 9	16 7 6	4 18 3	12.48
20	G	D	do.	318.42	5,384	19 4 9	2 4 10	21 9 7	16 17 9	4 11 10	12.74
21	AD	D	do.	267.71	4,202	16 3 5	1 15 0	17 18 5	14 4 5	3 14 0	12.75
22	X	D	do.	262.61	4,058	15 17 3	1 13 10	17 11 1	15 0 7	2 10 6	13.74
23	N	D	Guernsey	319.83	4,015	19 6 4	1 13 6	20 19 10	19 4 9	1 15 1	14.39
24	F	D	A.I.S.	286.74	4,295	17 6 3	1 15 10	19 2 1	18 6 1	0 16 0	15.32
25	Q	D	do.	269.28	4,718	16 5 3	1 19 4	18 4 7	21 15 9	—3 11 2	19.40
Average	...	...	...	309.31	4,423	18 13 9	1 16 10	20 10 7	11 5 1	9 5 6	8.73

Available Skim Milk = [Total Milk—60 gallons—10%]—120 gallons.

In computing the available skim milk, it is assumed that the calf consumes 60 gallons of whole milk, 10 per cent. of the milk goes with the cream, and a further 120 gallons of skim milk is fed to the calf.

TABLE VI.

HERDS IN ORDER OF MERIT AS PROFITABLE MILK PRODUCERS.

Place.	Herd.	Breed.	Average Milk per Cow for 9 months.	Value of Whole Milk at 1/- per gallon.	Cost of Feed per Cow for 9 months.	Profit per Cow.	Cost of Feed to produce 1 gallon Milk.
			lb.	£ s. d.	£ s. d.	£ s. d.	d.
1	Z	A.I.S. ...	9,747	48 15 0	11 14 11	37 0 1	2.89
2	AC	do. ...	7,992	39 19 0	6 19 3	32 19 9	2.09
3	AB	do. ...	8,000	40 0 0	8 6 11	31 13 1	2.50
4	T	do. ...	7,308	36 11 0	4 19 9	31 11 3	1.64
5	AA	do. ...	8,186	40 19 0	10 9 0	30 10 0	3.06
6	D	Guernsey ...	7,202	36 0 0	7 10 0	28 10 0	2.49
7	W	Jersey ...	6,619	33 2 0	6 9 3	26 12 9	2.34
8	S	do. ...	6,015	30 2 0	6 6 5	23 15 7	2.48
9	B	do. ...	5,283	26 8 0	2 16 7	23 11 5	1.29
10	V	A.I.S. ...	7,960	39 16 0	16 7 6	23 8 6	4.93
11	K	Jersey ...	5,729	28 13 0	5 7 3	23 5 9	2.25
12	G	A.I.S. ...	7,915	39 12 0	16 17 9	22 14 3	5.12
13	U	Guernsey ...	5,512	27 11 0	5 13 8	21 17 4	2.47
14	I	Jersey ...	6,162	30 16 0	9 0 4	21 15 8	3.51
15	E	do. ...	5,569	27 17 0	6 4 8	21 12 4	2.67
16	H	do. ...	5,406	27 1 0	6 6 1	20 14 11	2.80
17	M	Guernsey ...	6,745	33 15 0	14 15 9	18 19 3	5.26
18	AD	A.I.S. ...	6,602	33 0 0	14 4 5	18 15 7	5.17
19	R	Guernsey ...	5,581	27 18 0	10 7 9	17 10 3	4.47
20	X	A.I.S. ...	6,442	32 4 0	15 0 7	17 3 5	5.60
21	Y	Jersey ...	4,314	21 11 0	4 10 1	17 0 11	2.51
22	L	do. ...	6,669	33 7 0	16 17 4	16 9 8	6.07
23	F	A.I.S. ...	6,706	33 11 0	18 6 1	15 4 11	6.55
24	Q	do. ...	7,175	35 18 0	21 15 9	14 2 3	7.29
25	N	Guernsey ...	6,394	31 19 0	19 4 9	12 14 3	7.19
Average	...	... ...	6,848	34 5 0	11 5 1	22 19 11	3.94

"THE JOURNAL OF AGRICULTURE"

will be supplied free *on application* to any person in the State who is following Agricultural, Horticultural, or Viticultural pursuits, and to Agricultural Societies or Associations.

A charge of One shilling and threepence per copy will be made for the *Journal* to persons other than the foregoing, or who do not reside in the State. These applications, accompanied by the requisite amount, must be forwarded to the Under Secretary, Department of Agriculture, who will also receive all correspondence dealing with the conduct of the *Journal*.

Editors of Agricultural and Country papers are invited to reproduce any of the articles contained in this Journal, providing the usual acknowledgment is made.

If you are not receiving the *Journal*, which is issued quarterly, and wish to do so, please forward your name and postal address to the Under Secretary, Department of Agriculture, Perth.

F.A.Q. SAMPLES OF PAST SEASONS.

By L. W. Samuel,
Cereal Research Officer.

The Department of Agriculture has stored samples of the f.a.q. wheat of past seasons and it was considered of interest to examine these by the Pelshenke (1930-31) or wholemeal fermentation time test (Cutler & Worzella 1931) for baking quality. This test as conducted in this laboratory consists of making the doughball (in triplicate) from 5g. of wheat meal (Wiley mill, 1mm. sieve) with 2.7 mls. of a suspension of 10g. of compressed yeast in 108 mls. of water and immersing the doughball in water in a cabinet maintained at 32° C. At first the doughball sinks, but soon rises to the surface because of the production of carbon dioxide gas by the yeast. This time of rise is noted as a measure of the activity of the yeast and if the time of rise is more than 15 min. the test is repeated with fresh yeast

After rising to the surface the doughball continues to expand until finally the expansion causes disintegration of the ball. The time from placing the ball in the water till the first piece breaks off is considered to be a measure of the baking quality of the wheat, the longer the time the better the quality.

Twelve samples of f.a.q. wheat were available, the oldest being the 1919-20 season's sample. These were tested on 28th October, 1937, and the results are shown in Table 1 together with the "time" obtained for the more recent samples which were tested when the f.a.q. sample was obtained. Table 1 also shows the diastatic activity of the ground wheat as determined by the method of Blish & Sandstedt (1935).

The results are shown graphically in fig. 1.

Table 1.

Analyses of f.a.q. samples.

Season.	Diastatic activity mg. maltose/10g./hr.	Pelshenke time (mins.).	
	1.	1.	2.
1919-20	152	62	..
1921-22	122	59	..
1923-24	140	75	..
1924-25	198	78	..
1925-26	140	90	..
1927-28	136	61	..
1928-29	132	63	..
1929-30	152	62	..
1930-31	136	49	..
1932-33	214	53	..
1933-34	184	49	40
1934-35	184	51	31
1935-36	..	..	38
1936-37	..	..	36

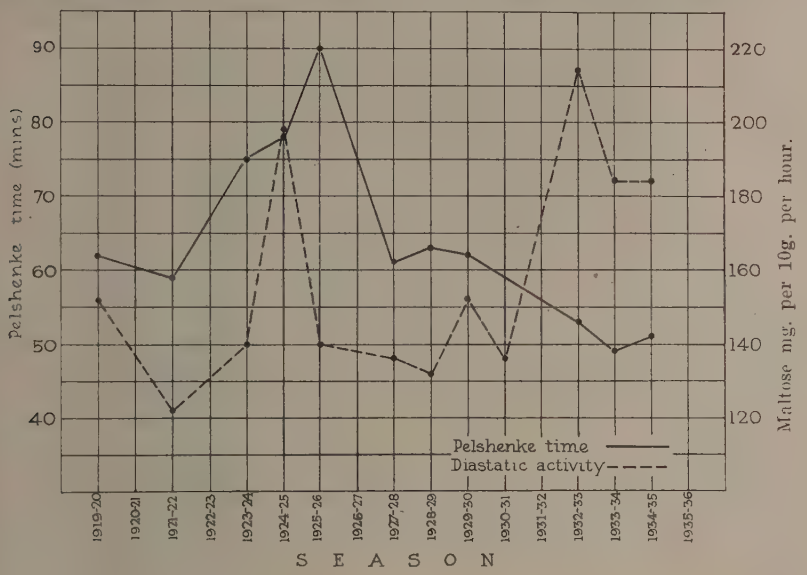
1. Tested 28th October, 1937.

2. Tested at time of fixing the f.a.q. standard.

The diastatic activity of the samples is very variable but does not appear to have any uniform trend. It is interesting to note that diastatic activity is still present in wheat stored for nearly 18 years.

The baking quality after storing as judged by the Pelshenke time is practically the same for the 1919-20 and 1921-22 seasons' samples, increases to a maximum for the 1925-26 season, decreases to practically the same value for the 1927-28 to the 1929-30 samples and then decreases to practically the same value for the 1930-31 to the 1934-35 samples.

Since there is no connection between the diastatic activity and the Pelshenke time there appears to be two explanations of the variation in "time." Either the



baking quality of the f.a.q. samples for the various seasons varied in this manner or the known improving effect of age on quality has increased the Pelshenke time to a maximum at about 12 years age and further aging has caused deterioration.

The second explanation seems the more acceptable because (a) other quality tests carried out on the samples at the time of collection do not indicate such variation in quality ; (b) there is no comparable variation in "time" for the 1933-34 to 1936-37 samples tested at the time of collection, showing that the quality of the f.a.q. sample has not varied greatly during these four seasons; (c) for the 1933-34 and 1934-35 samples where the Pelshenke times of the fresh and of the aged samples can be compared there is a definite increase in "time" for the aged samples.

It is suggested, therefore, that under the conditions of storage obtaining at the time the baking quality of Western Australian f.a.q. wheat increased to a maximum after about 12 years' storage and then decreased. This can only be regarded as a suggestion and it is intended to continue this work to confirm or disprove the results obtained in this test.

An improvement with age for 12 years is a much longer time than is generally reported in the literature, which is about three to four years, though deterioration may not occur till more than six years after harvesting.

REFERENCES.

Blish, M. J., and Sandstedt, R. M.:
1935: Cereal Laboratory Methods, 3rd Ed.

Cutler, G. H., and Worzella, W. W.:
1931: J. Amer. Soc. Agron. 23: 1000-09.

Pelshenke, P.:
1930-31: Arch. Pflanzenban 5: 108-51.

THE INOCULATION OF TANGIER PEAS.

W. P. Cass-Smith, B.Sc. Agr.,
Assistant Plant Pathologist.

INTRODUCTION.

The inoculation of leguminous seed with pure cultures of the requisite strains of root nodule bacteria has been practised in Western Australia since 1926. During that year a culture for the inoculation of lucerne seed was obtained from the Rothamsted Experiment Station, England, and the distribution of subcultures to farmers was commenced. Since that time, in order to meet an increasing demand, other strains have been introduced from various sources, and during the last three years the number of pure cultures supplied to farmers has averaged more than 1000 per year.

The results obtained have on the whole been very successful, more especially as the majority of inoculated seed has been planted on land recently cleared of native vegetation, or on which cultivated leguminous plants have not previously been grown.

At the present time nine strains of the root nodule bacteria are kept in stock by the Plant Pathological Branch of the Department of Agriculture, each of which is considered to be effective for the inoculation of a group of closely related leguminous plants (cross-inoculation group), but ineffective for plants outside that group (1). In practice over a number of years this has proved to be the case, and good results have been obtained by using a single strain of the nodule bacteria, e.g., the "pea" strain, for the inoculation of such members of the group as garden, field and sweet peas, broad and tick beans and vetches, etc.

Strain of bacteria required for the inoculation of Tangier Pea.

Recently some doubt has been expressed by farmers who have used the pea culture concerning its effectiveness for the inoculation of Tangier pea (*Lathyrus tingitanus*), "a plant which shows great promise as a fodder plant, and for green manuring, in districts with a winter rainfall of 16 inches or over." (2).

As it is now well recognised that a strain of root nodule bacteria effective with one plant species may be somewhat less effective with other species of the cross inoculation group, it was deemed advisable, in view of the potential agricultural importance of the Tangier pea, to isolate an effective strain directly from this plant.

Isolation of Tangier Pea Strain.

Mr. A. T. O'Connell, of Dwarda, who has grown Tangier peas very successfully in his district for a number of years, was approached, and from his 1936 crop he kindly selected a number of very vigorous Tangier pea plants, each of which bore a few very large nodules on the tap root, a feature by which efficient strain may be recognised, according to the work of Allen and Baldwin (3).

From these specimens one very large nodule from the upper portion of the tap root was chosen, and using the method described by Thornton (4) a bacterial strain was isolated.

Field Trial with Tangier Pea Culture.

In order to test the effectiveness of the new strain, Mr. O'Connell again co-operated with this Department and on June 1st, 1937, a preliminary experiment consisting of three trial plots was seeded with Tangier peas as follows:—

Plot (a) Seed uninoculated.

Plot (b) Inoculated by broadcasting soil taken from an old paddock in which Tangier peas had previously grown successfully (soil transfer).*

Plot (c) Seed inoculated with a pure culture of the Tangier pea nodule bacteria.

The land selected for the trial was fallowed sandy loam on which neither field, garden nor Tangier peas had previously been grown, carrying in the virgin state sheoak, jam, redgum and whitegum.

A dressing of about 1½ cwts. per acre of superphosphate was given to all plots and the sowing methods were such as to preclude as far as possible either the accidental introduction of the pure culture bacteria into plots (a) and (b) or their direct contact with the superphosphate.

RESULTS.

About the middle of October representative samples taken from each plot were forwarded by Mr. O'Connell to the Department of Agriculture for examination.

In addition to the greatly increased yield brought about by seed inoculation, another very marked feature was the variation in both size and number of nodules resulting from the different treatments.

The nodules on the specimens from plot (c) (inoculated with culture) were comparatively few in number, large in size and situated for the most part on the tap roots, whereas those from plot (b) (soil inoculation) were much more numerous, smaller in size and confined almost entirely to lateral rootlets. Only one nodule could be found on the specimens from plot (a) (uninoculated).

Yield.

An officer of the Department of Agriculture who happened to be in the Dwarda district towards the end of October inspected the plots and reported that their growth was roughly in the following order of relative magnitude:—

Plot (a) No inoculation	1
Plot (b) Soil transfer inoculation	2
Plot (c) Seed inoculated with pure culture	4

Thus by inoculating the seed with the pure culture before planting, a yield approximately four times that of the uninoculated plot and double that of the soil transfer plot was obtained.

* This was Mr. O'Connell's usual method of inoculation, for in the past it had given better results than seed inoculation with the Pea Culture.

(a) (b) (c)

Tangier pea plants showing the effects of inoculation with nitrogen-fixing bacteria. The plants were grown in soil not previously cropped with legumes, (a) without any inoculation. (b) Inoculated by means of soil taken from an old paddock in which Tangier peas had previously grown successfully. (c) Inoculated by means of seed inoculation with a special bacterial strain isolated from Tangier pea roots.

The relative growth was estimated as being in the ratio of 1:2:4.

Photo. by Govt. Printer.

Chemical Analysis.

Representative samples were cut from each plot by Mr. O'Connell towards the end of the growing period, dried in the shade and subsequently analysed by the Government Analyst, with the following results:—

	Plot (a).	Plot (b).	Plot (c).
	%	%	%
Moisture	8.53	8.40	8.62
Nitrogen*	2.26	2.34	2.42
Ash	5.22	4.48	5.48
Cr. Protein (N x 6.25)	14.12	14.62	15.12

* Calculated on dry basis.

Although the figures for nitrogen content are approximately the same for each treatment, yet when the proportionate yields are taken into account the increased nitrogen fixation on Plot (c) is very considerable.

CONCLUSIONS.

Although it is realised that the field trial described had some limitations from an experimental point of view which in the circumstances were unavoidable, the following conclusions may be drawn:—

(1) A strain of Tangier pea nodule bacteria has been isolated which in a preliminary trial gave excellent results as compared with the usual soil transfer method adopted by one of the most successful and biggest scale growers of Tangier peas in W.A. This strain is now available to farmers planting Tangier peas at the usual charges.

(2) Unsuccessful results may be expected when uninoculated Tangier peas are planted in soil which has not previously grown this crop, or such plants as field or garden peas, broad or tick beans and vetches.

(3) Further work to compare the relative effectiveness of the "Pea" and Tangier pea strains is required. Unfortunately an experiment carried out last year at the Denmark Research Station to elucidate this point proved a failure, owing to the ravages of red mite.

REFERENCES.

1. Pittman, H. A.—"Leguminous Crops and Their Place in the Building up of Soil Fertility." Journ. Dept. of Agric., W.A., Vol. 12 (2nd series), No. 2, June, 1935, pp. 105-116.

2. Baron-Hay, G. K.—"The Tangier Pea." Journ. Dept. of Agric., W.A., Vol. 13 (2nd series), No. 4, December, 1936, pp. 508-513.

3. Allen, O. N., and Baldwin, I. L. "The effectiveness of Rhizobia, as influenced by Passage through the Host Plant." Agric. Expt. Station, University of Wisconsin, Research Bull. 106, pp. 1-56, January, 1931.

4 Thornton, H. G.—"Lucerne Inoculation and the Factors affecting its Success." Imp. Bureau of Soil Science, Eng., Tech. Communication No. 20, pp. 16 and 17, 1931.

ROYAL AND DISTRICT AGRICULTURAL SOCIETIES' 50 ACRE CROP COMPETITIONS, 1937.

I. THOMAS,
Superintendent of Wheat Farming.

Fifty acre crop competitions were commenced in this State in 1921. Their object is to improve the farming methods of the State by creating a spirit of healthy rivalry among farmers and by focussing attention upon the methods of the successful competitors. They also enable farmers to make personal contact with the officers attached to the Wheat Branch of the Department who have been judges since the inception of the competitions.

Entry for these competitions is made through the local Agricultural Societies, the first and second prize winners of each local competition automatically becoming eligible to compete for the Royal Agricultural Society's zone prize. Where no local competition is conducted, entry is accepted direct with the Royal Agricultural Society and in this way no farmer desirous of doing so is prevented from participating.

On account of the great variation in soil and climatic conditions, the wheat-belt has been divided into eight zones in such a manner that districts having similar interests and climatic conditions are grouped together. In this way farmers compete with each other more equitably. The accompanying map shows the eight zones referred to.

In each zone a championship prize of £10 and a second prize of £2 10s. are awarded.

In addition to these prizes, the Royal Agricultural Society offers a special prize of £5 5s. to the competitor, in any zone, who obtains the highest calculated bushel yield per acre.

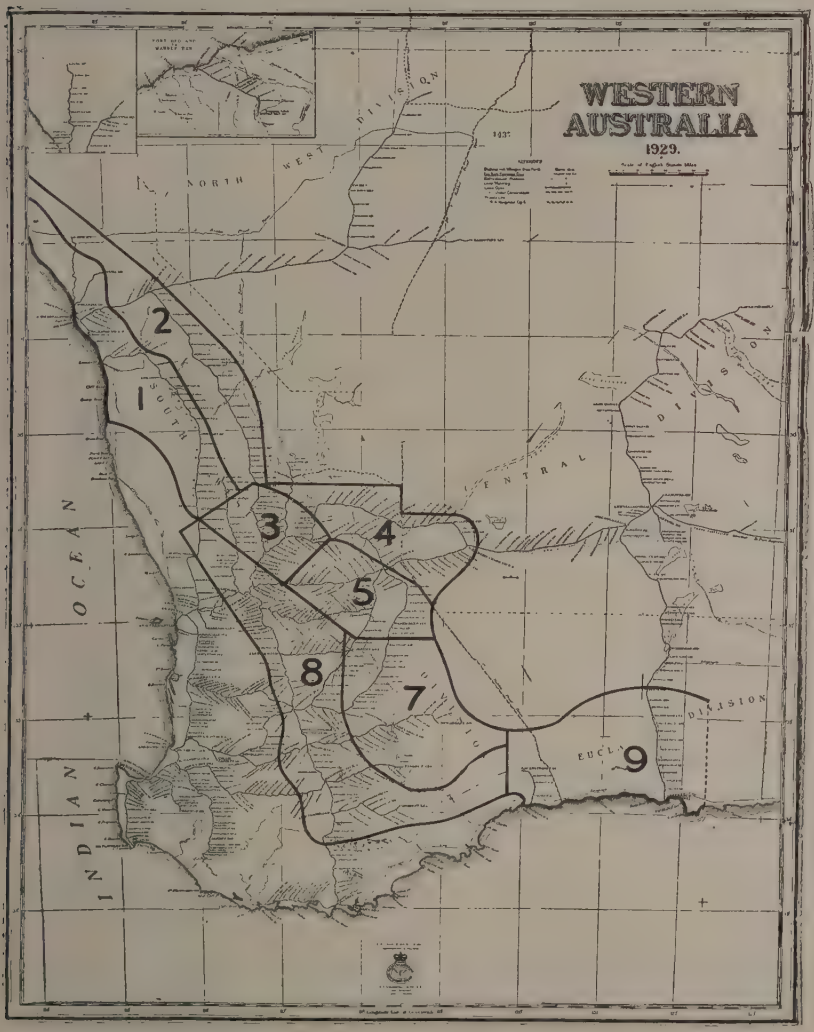
The conditions of the competitions require that the crop shall be grown on fallowed land, shall be not less than 50 acres in area of one variety, and shall be judged under the following scale of points:—

Yield	50 points
Freedom from weeds	10 „
Freedom from disease	10 „
Freedom from admixture	15 „
Evenness of growth	15 „
Total	100 points

The system is to allot one point for each bushel of the calculated yield per acre, which is determined by taking quadrate samples systematically throughout the crop, threshing and weighing the grain.

The 1937 season commenced well for all the wheat belt areas, excepting the North Eastern districts, with very good general rains during the third week of April. The less fortunate Eastern and North Eastern areas had to wait another

month for their first good rains which fell during the third week of May. These rains were the heaviest and most widespread that have been recorded for some years and at the end of May conditions were looking very promising for the whole of the Western Australian wheat belt.



Patchy June rains followed by an unusually long dry spell throughout July and early August reduced crop prospects in all centres and particularly in the Eastern and North Eastern areas, where soil moisture has been steadily depleted over three consecutive dry seasons. The dry spell terminated with general rains during the latter part of August and though rains thereafter were scanty some good yields have been obtained—particularly in the Southern areas.

The detailed awards made in each zone are as follows:—

ZONE 1.

Judge: N. Davenport, B.Sc. (Agric.), Agricultural Adviser.

Competitors: Three Springs, 4; Carnamah, 12; Royal, 1. Total, 17.

The rainfall recorded at Moora, Carnamah, Three Springs and Greenough is shown in the following table:—

	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Moora	....	....	74	130	308	349	84	329	177	13	1,260	77	....	1,541
Carnamah	31	....	....	170	372	236	66	252	90	5	1,021	16	....	1,238
Three Springs	17	5	....	158	331	280	61	264	83	7	1,026	21	4	1,231
Greenough	5	....	8	132	385	438	80	309	100	56	1,368	43	8	1,564

Tables showing the Judge's awards and details of the treatment received by the leading crops are given below.

CARNAMAH AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Catta, G.	Carnamah	Ford	32	9	9	13	13	76
Clarke, R. W.	do.	Sutton	30	9	9	14	13	75
Diamond, R. McW.	do.	Gluyas Early	29	8	9	14	13	73
Forrester, J. K.	do.	Merredin	29	8	9	14	13	73
Clarke, R. W. (jnr.)	do.	Nabawa	27	9	9	14	13	72
Bothe, B. D.	Coorow	Bencubbin	27	8	9	14	13	71
Rooke, F.	Carnamah	Merredin	27	9	9	14	12	71
Niven, R.	do.	Gluyas Early	27	9	8	14	12	70
Sargent, W. A. T.	do.	Merredin	25	9	8	14	14	70
Sivyer, K. J.	do.	Nabawa	27	9	9	13	12	70
Roberts, I. B.	Coorow	Waratah	19	9	9	13	14	64
Aunger, M. S.	Carnamah	Totadgin	21	8	7	12	12	60

Mr. G. Catta's winning crop of Ford was grown on salmon gum and gimlet country which had been cleared for many years. The land was ploughed to a depth of 4in. in June and July with a mouldboard plough and cultivated with a disc cultivating plough in September and again in October. It was planted with a disc drill during the first week of May, the rates of seed and superphosphate being 45 and 80 lbs. respectively.

Mr. R. W. Clarke's entry which obtained second place was a crop of Sutton grown on York gum and jam country which had been disc ploughed in mid-July to a depth of 4in. and cultivated with a disc cultivating plough in September. It was sown during the first week of May with a combined cultivator-drill, using 45 lbs. of seed and 100 lbs. of superphosphate per acre.

Mr. R. McW. Diamond's crop of Gluyas Early was grown on York gum, salmon gum and gimlet country which had been disc ploughed in July and again in September and cultivated with a disc cultivating plough—part in October and part in April. It was planted with a combined cultivator-drill in early May using 50 lbs. of seed and 100 lbs. of superphosphate per acre.

THREE SPRINGS AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Lynch, Senator P. J.	Three Springs....	Bencubbin	30	9	9	14	13	75
Turner Bros.	Arrino	Gresley	23	8	9	14	13	67
Connaughton, F.	Three Springs....	Gluclub	25	9	9	12	11	66
Hebiton, J. K.	do.	Pusa	22	8	9	13	12	64

Senator P. J. Lynch's winning entry of Bencubbin was grown on land which had originally carried salmon gum and York gum. It was ploughed in July to a depth of 4½ inches with a mouldboard plough and worked back with a disc cultivating plough in May. It was planted during the second week of June with a combined cultivator drill, 60 lbs. of seed and 60 lbs. of superphosphate being applied per acre.

Turner Bros.' crop of Gresley was grown on land which had carried York gum, mallee and tamma. It was disc-ploughed 3 inches deep in September and cultivated with a disc cultivating plough prior to sowing with a disc drill in early May. 60 lbs. of seed and 75 lbs. of superphosphate were applied per acre.

Mr. F. Connaughton's crop of Gluclub was grown on country similar to Senator P. J. Lynch's and received similar treatment. It was seeded, however, during the third week of June and the rates of seed and superphosphate were 60 and 80 lbs. respectively.

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Hockridge, W. J.	Moora	Royal	Sword	31	9	9	14	14	77
Catta, G.	Carnamah	Carnamah	Ford	32	9	9	13	13	76
Clarke, R. W.	do.	do.	Sutton	30	9	9	14	13	75
Lynch, Senator P. J	Three Springs	Three Springs	Bencubbin	30	9	9	14	13	75
Morrell Bros.	Greenough	Royal	Toby's Tusk	29	9	9	14	13	74
Turner Bros.	Arrino	Three Springs	Gresley	23	9	8	14	13	67

Mr. W. J. Hockridge's crop of Sword, which won the Zone prize of £10, was grown on land which originally carried York gum, jam, and white gum. It was ploughed 4 inches deep in June with a mouldboard plough and springtyne cultivated after rains in April. It was seeded during the second week of May with a combined cultivator drill applying 60 lbs. of seed and 90 lbs. of superphosphate per acre.

ZONE 2.

Judge: N. Davenport, B.Sc.(Agric.), Agricultural Adviser.

The seven competitors in this zone all entered direct with the Royal Agricultural Society.

The rainfall recorded at Damboring was as follows:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Damboring	8	35	....	47	223	239	40	234	65	56	857	95	....	1,042

The awards made are tabulated below:—

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
Lyon, L. D. & O. M.	East Damboring	Royal	Bencubbin	25	9	9	14	13	70
Sutcliffe, J. & G.	do.	do.	Gluclub	24	9	9	14	13	69
Meadows, T. C.	do.	do	do.	24	8	8	14	14	68
Harrington S. C.	do.	do.	do.	23	9	9	13	13	67
McKay & McKay	do.	do.	do.	22	9	9	14	12	66
Bradford, R.	do.	do	Bencubbin	20	9	9	14	13	65
Bradford, L.	do.	do.	do.	21	9	9	13	12	64

The winning crop of Bencubbin grown by Messrs. L. D. and O. M. Lyon was on land which had carried morrel and scrub. It was ploughed 4 inches deep in late July, cultivated in September with a springtyne implement and again in early May with a disc cultivating plough. It was planted with a combined cultivator-drill during the last week of May, the rates of seed and superphosphate being 45 lbs. and 100 lbs. respectively.

Messrs. J. and G. Sutcliffe's crop of Gluclub, which was awarded second place, was grown on land which had carried salmon gum and gimlet. It was ploughed 4½ inches in July, 1936, and cultivated with a springtyne implement in August and September and again in May. It was planted late in May with a combined cultivator drill, 34 lbs. of seed and 100 lbs. of superphosphate being applied.

Mr. T. C. Meadow's entry of Gluclub on similar country was disc ploughed 4 inches deep in July, springtyne cultivated in August and September and planted at the end of May with a combined cultivator-drill, the rates of seed and superphosphate being 40 lbs. and 100 lbs. respectively.

ZONE 3.

Judge: F. L. Shier, B.Sc.(Agric.), Agricultural Adviser.

Competitors: Ballidu, 7; Wyalkatchem, 2; Royal, 7. Total, 16.

The rainfall for the year at the centres concerned in the Zone 3 competition is shown below:—

	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Wongan Hills	5	102	112	296	199	32	203	50	20	800	171	....	1,190
Ballidu	7	20	13	46	263	194	40	250	72	34	853	90	....	1,029
Goomalling	6	7	84	220	217	84	210	31	11	773	94	2	966
Calingiri	11	29	132	304	356	94	306	80	14	1,154	62	....	1,388
Minnivale	12	25	56	308	271	31	197	51	12	870	30	....	993
Cowcowing 22	15	3	35	246	175	29	190	55	11	706	70	....	851

The awards made are set out below:—

BALLIDU AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Ackland, H.	Wongan Hills....	Bencubbin	30	9	9	14	13	75
Knapp, J.	Ballidu	do.	29	8	9	14	13	73
Thomas, W.	do.	Gluclub	28	8	9	13	13	71
Goodie, H.	do.	Golden King	28	9	7	14	13	71
Petchell, R.	do.	Gluclub	25	9	9	13	13	69
Beilby, A.	do.	Bencubbin	23	8	9	14	13	67
Nelson, F.	do	do.	22	8	9	12	13	64

The winning crop of Bencubbin entered by Mr. H. Ackland was grown on jam and York gum country. It was ploughed in early June, 1936, with a mouldboard plough and cultivated in September and in May with a springtyne cultivator. It was seeded during the 3rd week of May, the rates of seed and superphosphate being 50 and 120 lbs. respectively.

Mr. J. Knapp's crop of Bencubbin was planted on land which had carried salmon gum, gimlet and morrel. It was ploughed in June with a disc cultivating plough and cultivated in September and again in early January. Seeding was carried out on the 23rd of May, and 45 lbs. of seed and 90 lbs. of superphosphate were applied per acre.

Mr. W. Thomas' crop of Gluclub was on land which had carried gimlet and scrub and which had been ploughed in July with a disc cultivating plough and

springtyne cultivated in September. It was seeded during the last week of May at the rate of 48 lbs. per acre. Superphosphate was applied at 120 lbs. per acre.

WYALKATCHEM AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Lawrence, A. E.	Benjaberring	Rajah	25	9	9	13	13	69
Lehman, C. E.	Cowcowing	Bencubbin	18	9	9	14	14	64

The winning crop, grown by Mr. A. E. Lawrence, was on land which had carried salmon gum and scrub, and had been ploughed with a disc implement in July and springtyne cultivated in September and again in April. Seeding was carried out during the 3rd week of May, the rates of seed and superphosphate being 36 and 120 lbs. respectively.

Mr. C. E. Lehman's crop as on country which had carried mixed timbers, mallee and scrub, and had been farmed for five years. It was disc ploughed in late July, scarified in September and seeded at the middle of May with a combined cultivator-drill. Seed and superphosphate were applied at 45 and 85 lbs. per acre respectively.

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Ackland, H.	Wongan Hills	Ballidu	Bencubbin	30	9	9	14	13	75
Knapp, J.	Ballidu	do.	do.	29	8	9	14	13	73
Johnson, F. B., & Sons	Goomalling	Royal	do.	28	9	9	13	13	72
Edmonds, B. J.	Calcarra	do.	Nabawa	28	9	7	14	13	71
Waterhouse, E. J.	Goomalling	do.	Bencubbin	26	9	9	13	14	71
Hughes, J. R.	Minnivale	do.	do.	26	9	9	14	13	71
Lawrence, A. E.	Benjaberring	Wyalkatchem	Rajah	25	9	9	14	13	70
Vallence, H.	Minnivale	Royal	Bencubbin	24	9	9	14	13	69
Hesford, T. W.	do.	do.	Gluclub	24	9	9	13	14	69
Williams, J. D.	Piawaning	do.	Nabawa	22	9	9	14	13	67
Lehman, C. E.	Cowcowing	Wyalkatchem	Bencubbin	18	9	9	14	14	64

Messrs. F. B. Johnson and Sons' crop of Bencubbin, which was awarded third place in the Zone competition, was grown on land which had carried York gum, salmon gum and jam, and had been ploughed with a mouldboard plough in June and cultivated in September and in May with a springtyne cultivator. Seeding was done in mid-May, the rates of seed and of superphosphate being 70 and 90 lbs. per acre respectively.

ZONE 4.

Judge: W. M. Nunn, B.Sc.(Agric.), Agricultural Adviser.

Competitors: Mt. Marshall, 5; Nungarin and Eastern Districts, 6. Total, 11.

The rainfall for the year recorded at Nungarin, Bencubbin, Yorkrakine and Gabbin is set out below:—

	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Nungarin	32	15	44	42	238	132	52	174	37	21	654	69	3	859
Yorkrakine	....	1	8	38	239	179	50	177	37	15	697	54	....	798
Bencubbin	57	3	52	46	211	126	29	164	36	17	583	83	....	824
Gabbin	91	13	21	32	212	110	44	229	67	28	690	49	....	894

The awards made are set out below, and descriptions are given of the treatment received by the leading crops.

MT. MARSHALL AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Hopwood, B. W. G.	Bencubbin	Bencubbin	18	8	9	14	14	63
Purdom, B.	do.	do.	17	6	9	14	13	59
Mill, J.	Gabbin	Totadgin	14	8	7	14	12	55
Perry Bros.	Bencubbin	Gluyas Early	10	9	8	14	12	53
Gobbart, W., & Sons	Gabbin	Bencubbin	12	5	9	14	12	52

Mr. B. W. G. Hopwood's winning crop of Bencubbin was grown on land which had carried mallee and scrub and was disc ploughed 3 inches deep in June, springtyne cultivated in early August and seeded on the 7th of May. Seed and superphosphate were applied at 45 and 120 lbs. per acre resepectively.

Mr. B. Purdom's crop—also of Bencubbin—was on land which had carried salmon gum, gimlet, mallee and scrub, was disc-ploughed 3 inches deep in August, springtyne cultivated in September and seeded during the third week of May, 45 and 90 lbs. being the rates of seed and superphosphate respectively.

Mr. J. Mills' crop of Totadgin, which occupied third place, was on land which three years ago carried mallee and scrub. It was disc-ploughed 4 inches deep in late July and disced again in April to cut out scrub. Seeding was carried out during the second week of May, 50 lbs. of seed and 100 lbs. of superphosphate being applied.

NUNGARIN AND EASTERN DISTRICTS AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Fitzpatrick, R. C.	Nungarin	Bencubbin	22	8	9	14	12	65
Diver, L. C.	Yelbeni	Totadgin	20	9	9	14	12	64
Bodey, W., & Sons	Nungarin	Bencubbin	18	8	9	12	12	59
Creagh Bros	do.	Noongaar	17	7	8	14	13	59
Jolly, H. P.	do.	Bencubbin	17	8	9	14	11	59
Watson Bros.	do.	Noongaar	13	6	9	14	10	52

Mr. R. Fitzpatrick's winning crop of Bencubbin was on jam and mallee country which had been under cultivation for 12 years but left out for several consecutive years prior to fallowing in 1936. It was disc-ploughed 3 inches deep in early June and seeded during the first week of May, 45 lbs. of seed and 100 lbs. of superphosphate being applied.

Mr. L. C. Diver's crop of Totadgin, which was awarded second place, was on land which had carried salmon gum, gimlet and mallee. It was disc-ploughed 3 inches deep in early June, springtyne cultivated in July and again in September and seeded during the fourth week of May. Seed and superphosphate were applied at the rate of 60 and 80 lbs. per acre respectively.

Messrs. W. Bodey and Sons' crop of Bencubbin was on similar country which had been cultivated with a rigid tyne scarifier to a depth of 3 inches in July and re-scarified in September and seeded during the fourth week of May, 40 lbs. and 100 lbs. per acre being the rates of seed and superphosphate respectively.

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Fitzpatrick, R. C.	Nungarin	Nungarin and Eastern Districts	Bencubbin	22	8	9	14	12	65
Diver, L. C.	Yelbeni	do.	Totadgin....	20	9	9	14	12	64
Hopwood, B. W. G.	Bencubbin	Mt. Marshall	Bencubbin	18	8	9	14	14	63
Purdom, B.	do.	do.	do.	17	6	9	14	13	59

ZONE 5.

Judge: W. M. Nunn, B.Sc.(Agric.), Agricultural Adviser.

Competitors: Bruce Rock, 8; Merredin, 6. Total, 14.

The rainfall for the year recorded at Bruce Rock, Merredin, Burracoppin and Erikin is as follows:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Bruce Rock	4	9	47	61	223	144	45	231	49	37	729	154	4	1,008
Merredin	20	3	49	60	235	164	46	198	45	29	717	78	10	987
Burracoppin	16	....	103	71	249	145	36	166	53	32	681	156	10	1,037
Merredin Research Station	25	6	31	31	206	164	37	155	47	28	637	96	6	832

The detailed awards are set out below:—

BRUCE ROCK AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Ellis, E. G. & M. P.	Ardath	Bencubbin	25	9	9	11	13	67
Perkins, C. C.	Belka	do.	19	8	9	14	14	64
Jones, R.	Shackleton	Gluclub	20	9	9	12	13	63
Garrett, G.	Ardath	do.	19	9	8	13	13	62
Starcevitch, J.	Korbel	Bencubbin	18	9	9	12	13	61
Butler, W. J.	Bruce Rock	do.	19	8	9	11	13	60
Fuchsbichler, M.	do.	do.	16	8	9	11	11	55
Spiller, H.	Erikin	Pusa 4	13	9	9	10	12	53

The winning crop entered by Messrs. E. G. and M. P. Ellis was a crop of Bencubbin grown on salmon gum and jam country. It was disc-ploughed 3 inches deep in June, springtyne cultivated in August, harrowed in September and seeded during the third week of May, 60 lbs. of seed and 90 lbs. of superphosphate being applied per acre.

Mr. C. C. Perkins' crop of Bencubbin was on land which had carried jam and scrub. It was rigid-tyne scarified 2½ inches deep in June, springtyne cultivated in August and again in September. It was seeded during the third week of May, 45 and 115 lbs. respectively of seed and superphosphate being applied per acre.

Mr. R. Jones' crop of Gluclub was grown on salmon gum and gimlet country which was disc-ploughed 3½ inches deep in June and springtyne cultivated in August, October and April. It was seeded during the fourth week of May, the rates of seed and superphosphate being 45 and 90 lbs. per acre respectively.

MERREDIN AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Thyne, T. K.	Norpa	Bencubbin	20	8	9	14	13	64
McPharlin, E. B., & Sons	South Burracoppin	do.	19	8	9	14	12	62
Harling, H.	Belka	Totadgin	17	9	9	14	12	61
Flockart, I. H.	Merredin	Bencubbin	16	8	9	14	12	59
Barnett, L. T. C.	Walgoolan	do.	14	7	8	12	10	51
Robartson, R.	Nangeenan	Totadgin	12	8	9	12	9	50

Mr. T. K. Thyne's winning crop of Bencubbin was grown on land which had carried mallee and scrub. It was disc-ploughed to 3½ inches in June and spring-tyne cultivated in August and seeded 1st of May, 45 lbs. of seed and 90 lbs. of superphosphate being applied.

Messrs. E. B. McPharlin and Sons' crop of Bencubbin was grown on gimlet and mallee country which had been cleared for eight years, rigid-tyne scarified 3 inches deep in June, rescarified in August and again in September. It was seeded in mid-May, the rates of seed and superphosphate being 45 and 120 lbs. respectively.

Mr. H. Harling's crop of Totadgin was on land which had carried salmon gum and gimlet. It was rigid-tyne scarified in June and again in August. Seeding was done on the 28th of May, the rates of seed and superphosphate being 42 and 112 lbs. per acre respectively.

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Ellis, E. G. & M. P.	Ardath	Bruce Rock	Bencubbin	25	9	9	11	13	67
Thyne, T. K.	Norpa	Merredin	do.	20	8	9	14	13	64
Perkins, C. C.	Belka	Bruce Rock	do.	19	8	9	14	14	64
McPharlin, E. B., & Sons	South Burracoppin	Merredin	do.	19	8	9	14	12	62

ZONE 7.

Judge: A. S. Wild, B.Sc.(Agric.), Agricultural Adviser.

Competitors: Kukerin, 9; Karlgarin, 9; Lake Grace, 12; Kulin, 17. Total, 47.

The rainfall for the year recorded at Kukerin, Karlgarin, Kondinin, Kulin and Lake Grace is set out below.—

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Karlgarin	....	....	225	43	190	186	20	214	24	31	665	141	....	1,074
Kukerin	....	2	420	114	357	301	109	265	76	59	1,167	205	6	1,914
Lake Grace	2	....	392	79	290	260	50	248	38	28	914	162	10	1,559
Kondinin	....	....	81	70	312	245	34	184	37	34	846	120	....	1,117
Kulin	....	....	2	115	99	320	188	43	253	56	41	901	189	....	1,306

The detailed awards and treatments received by the leading crops are given below.

KUKERIN AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
English, A. R.	Kukerin	Bencubbin	41	9	9	12	14	85
Bairstow, F.	Moulyinning	Gluclub	38	9	8	13	14	82
Bahr, O. E.	Merilup	Yandilla King	37	9	8	13	13	80
Faulkner, W. J.	North Kukerin	Bencubbin	31	8	9	14	14	76
Morris, P.	Moulyinning	Gluclub	33	9	8	13	13	76
English, J. C.	Merilup	Bencubbin	31	8	9	12	13	73
Ditchburn, S.	Tarin Rock	Free Gallipoli....	28	9	9	12	14	72
Gard, Wm.	Merilup	Gluclub	28	9	7	13	13	70
Nenke, B.	Kukerin	Bencubbin	27	8	8	14	13	70

Mr. A. R. English's crop of Bencubbin which won the Zone prize and also the special prize for the highest calculated yield per acre, was grown on land which had originally carried York gum and jam. It was scarified to a depth of 2 inches in June and received the same treatment in August and again in March. It was seeded during the second week of May with a combined cultivator-drill, the rates of seed and superphosphate being 45 and 95 lbs. per acre respectively.

Mr. F. Bairstow's crop of Gluclub was on land which had carried morrel and salmon gum. It was scarified in August to a depth of 3 inches and again in September, and received the same treatment just prior to seeding with a combined cultivator-drill during the second week of June. Seed and superphosphate were applied at the respective rates of 54 and 98 lbs. per acre.

Mr. O. E. Bahr's crop of Yandilla King was grown on land which had carried York gum, salmon gum and morrel and was ploughed 3 inches deep with a mouldboard plough, scarified in September and springtyne cultivated in April. It was seeded with a combined cultivator-drill during the first week of May, the rates of seed and superphosphate being 45 and 50 lbs. per acre respectively.

KARLGARIN AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
James, S. W.	Karlgarin	Bencubbin	26	8	9	14	13	70
Richter Bros	do.	do.	24	9	9	14	13	69
Finemore, A.	do.	do.	26	8	9	12	13	68
Shawyer, C.	do.	do.	23	8	9	13	13	66
Spurr, E. F.	do.	Gluyas Early	22	8	9	12	13	64
Trestrail, S. J.	do.	Bencubbin	21	8	9	13	13	64
Marshall, H. J.	Hyden	do.	21	8	9	13	12	63
Medcalf, C. W.	Karlgarin	do.	22	8	9	12	12	63
Walton, A. H.	do.	do.	17	8	9	13	12	59

Mr. S. W. James' winning crop of Bencubbin was grown on salmon gum, morrel and mallee country which had been cropped five times previously. It was scarified in early July to a depth of 2½ inches, received the same treatment in September and was scarified 2 inches deep in March. It was seeded with a combined cultivator-drill during the second week of May, 45 lbs. of seed and 90 lbs. of superphosphate being applied per acre.

Richter Bros.' crop of Bencubbin was on land which originally carried salmon gum, gimlet and mallee. It was ploughed 3½ inches deep with a mouldboard plough, scarified to 3½ inches in July and scarified to 2 inches in August and in March. Seeding was done with a combined cultivator-drill during the fourth week of May, 50 lbs. of seed and 110 lbs. of superphosphate being applied per acre.

Mr. A. Finemore's crop of Bencubbin was the eighth crop to be grown on the land which carried gimlet, salmon gum and mallee. It was disc ploughed 4 inches deep in early June and springtyne cultivated in August. It was then disced to 2 inches in September, springtyne cultivated in March and planted with a combined cultivator-drill during the fourth week of May, the rates of seed and superphosphate being 43 and 120 lbs. per acre respectively.

LAKE GRACE AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Kay, W. H. & F. C.	Lake Grace	Gluclub	38	9	7	12	14	80
Darby, A. H.	do.	Bencubbin	31	9	9	13	13	75
Bishop, S. J.	do.	do.	29	9	9	13	14	74
Carruthers, R. (jun.)	do.	Gluclub	32	7	8	13	14	74
Bennett, E. W.	do.	Totadgin	27	8	9	14	14	72
Carruthers, W.	South Lake Grace	Bencubbin	29	9	8	12	14	72
Coad, H. J.	Lake Grace	do.	28	9	9	13	13	72
Kealley, E. E.	South Lake Grace	do.	27	9	8	13	13	70
Betham, W.	Lake Grace	Gluyas Early	27	8	8	12	13	68
Fry, E. H.	North Lake Grace	Bencubbin	26	8	8	13	13	68
Jones, G. & D.	Lake Biddy	do.	25	9	8	13	13	68
Morton, W. K.	do.	do.	28	8	7	12	13	68

The winning crop entered by Messrs. W. H. and F. C. Kay was grown on land which had carried salmon gum, morrel and gimlet. It was scarified in July to a depth of 3-3½ inches and again in August to a depth of 2 inches. It was springtyne cultivated in March and seeded in mid-April with a combined cultivator-drill, 50 lbs. of seed and 100 lbs. of Superphosphate being applied per acre.

Mr. A. H. Darby's crop of Bencubbin was on salmon gum and gimlet country which had been scarified 2-2½ inches deep in December, 1935, disc ploughed 3 inches in July and scarified in August. It was springtyne cultivated in September and again in October and seeded during the first week of May with a combined cultivator-drill. The rates of seed and superphosphate were 50 and 112 lbs. per acre respectively.

Mr. S. H. Bishop's entry of Bencubbin was grown on salmon gum and gimlet country which had been disc ploughed 3 inches deep in July and again late in August. It was springtyne cultivated in March and disced 2 inches deep before planting in the second week of May with a combined cultivator-drill. The rates of seed and superphosphate used were 45 and 120 lbs. per acre respectively.

KULIN AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Biggin, H.	Kondinin	Totadgin	31	9	9	13	14	76
Stubbs, W.	do.	Bencubbin	31	9	9	12	14	75
Gray, J. S.	Kulin	Gluclub	31	8	8	12	14	73
Clayton, R., & Sons	Jitarning	Sword	30	8	8	13	13	72
Evans, H.	Kulin Rock	Bencubbin	28	9	9	13	13	72
Bele, J. H.	do.	do.	28	8	9	12	13	70
Bowey, P. J.	Kulin	do.	27	8	8	13	13	69
Freebairn, F. S.	Kulin Rock	Gluclub	26	9	8	12	14	69
Gordon, C. G.	Kulin	Bencubbin	25	9	9	12	14	69
Gray, J. S. (Mittakeri)	Jilakin	do.	25	9	9	13	12	68
Eyres, T.	Jitarning	Totadgin	24	9	9	13	12	67
Gamble, A. J.	Kondinin	Bencubbin	26	8	9	11	13	67
McInnes & Ryan	Kulin	Queen Fan	25	8	8	13	13	67
Bartlett, J.	do.	Bencubbin	23	9	8	13	13	66
McGrath, M.	Kulin Rock	Rajah	25	8	8	12	13	66
Meikle, P.	do.	Bencubbin	23	8	9	13	13	66
Riseborough, A.	Jilakin	do.	25	8	8	13	12	66

Mr. H. Biggin's winning entry of Totadgin was grown on land which had carried salmon gum, gimlet and mallee. It was disc ploughed 3-4 inches deep in early July, scarified in early September and planted with a combined cultivator-drill during the first week of May. 45 lbs. of seed and 100 lbs. of superphosphate were used per acre.

Mr. W. Stubbs' crop of Bencubbin was the seventh crop grown on an area of salmon gum, York gum, jam and gimlet country which was disc ploughed 3 inches deep in June and springtyne cultivated in August and September. It was sown with a combined cultivator drill during the third week of April, 48 lbs. of seed and 90 lbs. of superphosphate being added per acre.

Mr. J. S. Gray's crop of Gluclub was grown on mallee York gum, and jam country which was ploughed 3-3½ inches deep with a mouldboard plough. It was springtyne cultivated in September and planted with a combined cultivator drill during the fourth week of April. 60 lbs. of seed and 100 lbs. of superphosphate were used per acre.

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts
English, A. R.	Kukerin	Kukerin	Bencubbin	41	9	9	12	14	85
Bairstow, F.	Moulyinning	do.	Gluclub	38	9	8	13	14	82
Kay, W. H. & F. C.	Lake Grace....	Lake Grace....	do.	38	9	7	12	14	80
Biggin, H.	Kondinin	Kulin	Totadgin	31	9	9	13	14	76
Darby, A. H.	Lake Grace....	Lake Grace....	Bencubbin	31	9	9	13	13	75
Stubbs, W.	Kondinin	Kulin	do.	31	9	9	12	14	75
James, S. W.	Karlgarin	Karlgarin	do.	26	8	9	14	13	70
Richter Bros.	do.	do.	do.	24	9	9	14	13	69

ZONE 8.

Judge: R. P. Roberts, B.Sc. (Agric.) Hons., Agricultural Adviser.

Competitors: Gnowangerup, 7; Wickepin, 5; Royal, 8. Total, 20.

The rainfall recorded at the centres concerned in this zone is as hereunder:

——	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Gnowangerup....	2	....	380	131	286	202	52	220	69	45	874	81	16	1,482
Wickepin	....	7	101	247	445	348	85	272	76	31	1,257	56	....	1,668
Yilliminning	....	....	246	153	325	303	107	300	61	51	1,147	51	....	1,597
South Caroling	12	10	146	311	164	35	180	36	50	776	149	..	1,093	
Muresk	5	9	14	135	367	271	91	301	70	27	1,127	81	....	1,371
Toodyay	....	30	16	179	455	290	129	326	105	35	1,340	77	....	1,642
Broomehill	8	1	280	248	360	268	82	278	93	103	1,184	53	4	1,778
York	3	6	9	184	419	238	89	330	53	34	1,163	121	....	1,486
Noman's Lake	1	187	187	331	322	64	291	52	44	1,104	82	....	1,561	
Borden	1	1	149	66	265	134	63	197	77	30	766	224	12	1,219

The awards and the particulars of the treatment received by the leading crops are as follows:—

GNOWANGERUP AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Aylmore, A. E.....	Gnowangerup....	Nabawa	37	9	9	14	13	82
Cockram, C. E.	do.	Gallipoli	35	9	9	13	13	79
Garnett, V.	do.	Bencubbin	36	8	8	13	13	78
Stewart, W. B.	Borden	do.	33	9	9	13	13	77
McDonald, J. V. & A. R.	Gnowangerup....	do.	33	8	7	13	11	72
White, R. H.	do.	do.	28	8	9	12	13	70
Formby, R., & Coy.	do.	do.	28	8	6	14	13	69

Mr. A. E. Aylmore's winning crop of Nabawa was grown on land which had carried York gum, white gum and salmon gum. It was ploughed with a mouldboard 3 inches deep in July and scarified in August and in May. Seeding was carried out in early June, 60 lbs. of seed and 90 lbs. of superphosphate being applied per acre.

Mr. C. E. Cockram's crop of Gallipoli was on morrel, York gum and salmon gum country which had been cleared four years and had been ploughed 3 inches deep with a mouldboard implement in July. It was springtyne cultivated in March and April and seeded on the 19th of May. The rates of seed and superphosphate were 55 and 130 lbs. per acre respectively.

Mr. V. Garnett's crop of Bencubbin was grown on York gum and morrel country which had been mouldboard ploughed 3½ inches deep in July, scarified in spring and springtyne cultivated in autumn. Seeding was carried out during the

fourth week of May, 52 lbs. of seed and 90 lbs. of superphosphate being used per acre.

WICKEPIN AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Dalton, L. J.	Wickepin	Bencubbin	35	8	9	13	13	78
McDonald, W. G.	Noman's Lake	do.	27	8	9	13	13	70
Fleay & Sons	Wickepin	do.	28	8	7	12	11	66
Pense, G.	do.	Dundee	24	7	8	13	12	64
Doncon, E.	do.	Bencubbin	22	7	8	13	12	62

Mr. L. J. Dalton's winning crop of Bencubbin was grown on salmon gum and gimlet country which had been cleared five years, ploughed with a mouldboard implement 3½ inches deep in August and springtyne cultivated in May. The crop was seeded during the third week of May, 70 lbs. of seed and 90 lbs. of superphosphate being used per acre.

Mr. W. G. McDonald's crop was on land which had carried morrel, York gum and jam. It was disc-ploughed to 2 inches in June, harrowed in September and springtyne cultivated three times in April and May. Seeding was carried out during the third week of May, 45 and 110 lbs. per acre being the respective rates of seed and superphosphate applications.

Messrs. Fleay & Sons' crop of Bencubbin was planted on morrel country which had been cleared for eight years, ploughed with a disc-cultivating plough in July and springtyne cultivated after the March rains. Seeding was carried out in mid-May, seed and superphosphate being applied at the rates of 60 and 90 lbs. per acre respectively.

ROYAL AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Aylmore, A. E.	Gnowangerup	Gnowangerup	Nabawa	37	9	9	14	13	82
Cockram, C. E.	do.	do.	Gallipoli	35	9	9	13	13	79
Dalton, J.	Wickepin	Wickepin	Bencubbin	35	8	9	13	13	78
Brooks, A. W.	East Narrogin	Royal	do.	34	8	9	14	13	78
Richards, A.	South Caroling	do.	Totadgin	33	9	9	13	13	77
Boyle, T. K.	Greenhills	do.	Dundee	33	8	9	13	13	76
Burgess, W. G.	Burges Siding	do.	Bencubbin	32	8	9	14	13	76
Lloyd, C. J.	Toodyay	do.	Nabawa	33	8	8	12	14	75
Taylor, C.	Broomehill	do.	Bencubbin	32	8	9	13	13	75
Boyle, K. C.	York	do.	Merredin	31	9	8	11	14	73
Beeck, N. H.	Broomehill	do.	Gallipoli	32	8	8	12	12	72
McDonald, W. G.	Noman's Lake	Wickepin	Bencubbin	27	8	9	13	13	70

ZONE 9.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

The six competitors in this zone all entered through the Phillips River Agricultural Society.

The rainfall recorded at Ravensthorpe, Lake King and Mt. Short was as follows:—

	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Ravensthorpe....	8	9	381	46	148	280	61	277	199	91	1,056	250	5	1,755
Lake King	19	1	490	69	162	155	60	214	40	72	703	231	1	1,514
Mt. Short	4	3	302	46	114	130	61	243	132	44	724	186	....	1,265

The awards are set out in the following table:—

PHILLIPS RIVER AGRICULTURAL SOCIETY.

Competitor.	Address.	Society.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
				50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Daw, F. E.	Ravensthorpe	Phillips River	Gluclub	33	8	8	13	13	75
Bebbington Bros.	do.	do.	Bencubbin	29	8	8	13	13	71
Barrett, T. M.	do.	do.	Nabawa	27	8	8	14	12	69
Chambers Bros.	do.	do.	do.	25	8	9	12	13	67
Atkins, G. H.	Lake King	do.	Bencubbin	20	8	9	13	13	63
Campbell, J.	Mt. Short	do.	do.	19	7	8	14	12	60

Mr. F. E. Daw's winning crop of Gluclub was grown on salmon gum and gimlet country which had been cleared eight years and which was disc-ploughed 3½ inches deep in August, springtyne cultivated in October and again in April. Seeding was done during the first week of June, 45 lbs. of seed and 75 lbs. of superphosphate being applied per acre.

Messrs. Bebbington Bros.' crop of Bencubbin was grown on an area of salmon gum and mallee country which was disc-ploughed 3½ inches deep in July, springtyne cultivated in September, and seeded with a combined cultivator-drill in mid-May, 45 lbs. of seed and 90 lbs. of superphosphate being used per acre.

Mr. T. M. Barrett's crop of Nabawa was the third crop grown on an area of salmon gum and gimlet country which was disc-ploughed 3½ inches deep in July, springtyne cultivated twice in September and again in early April. Seeding was carried out with a combined cultivator-drill during the first week of May, 45 lbs. of seed and 95 lbs. of superphosphate being applied per acre.

ENTRIES.

Entries were received from 15 District Agricultural Societies, totalling 122 entrants. The Royal Agricultural Society received 16 entries direct, making the total number of competitors 138.

The following table shows the number and the average yield obtained each year since the competition was inaugurated:—

Year.	Number of District Agricultural Societies Competing.	Number of Competitors.	Average Yield of Competitors.	Average Yield for State.
1921	...	15	25	10.4
1922	...	32	24	8.9
1923	12	82	29	11.4
1924	15	70	31	12.8
1925	13	59	22.5	9.7
1926	11	99	24.5	12.0
1927	10	100	26.9	12.1
1928	13	114	22.5	10.1
1929	12	156	21.7	11.0
1930	15	165	27.4	13.3
1931	13	110	27.4	13.1
1932	17	168	29.3	12.3
1933	17	130	27.2	11.7
1934	17	114	26.8	9.8
1935	16	97	24.8	9.2
1936	12	80	21.0	8.4
1937	15	138	25.7	10.9*

* Estimate.

YIELDS.

The special prize of £5 5s. for the competitor obtaining the highest calculated yield per acre was awarded this year to Mr. A. R. English, of Kukerin, who obtained a yield of 41 bushels with the variety Bencubbin.

The winners of this prize to date are:—

	Bush. per Acre.
1925—Hebiton & Sons, Three Springs—Nabawa	34
1926—Cumming Bros., Carnamah—Yandilla King ..	38
1927—A. W. Parkinson, Gnowangerup—Yandilla King ..	40
1928—A. W. Parkinson, Gnowangerup—Yandilla King ..	40
1929—C. E. Cockram, Pallinup—Yandilla King	46
1930—C. Smith & Sons, Yarding—Gluclub	43
1931—H. O. Beeck, Gnowangerup—Yandilla King ..	42
1932—F. S. Freebairn, Jilakin—Gluclub	47
1933—D. Davis, Gnowangerup—Bencubbin	43
1934—C. E. Cockram, Pallinup—Free Gallipoli	40
1935—E. Davis, Gnowangerup—Bencubbin	41
1936—C. E. Cockram, Pallinup—Free Gallipoli	30
1937—A. R. English, Kukerin—Bencubbin	41

Of the 138 entries in this year's competition thirty-nine crops went 24 to 27 bushels; eight went 34-39 bushels; and one, the winner, went 41 bushels.

A list of the competitors who obtained 30 bushels and over is given below:—

Zone.	Competitor.	Address.	Society.	Variety.	Estimated Yield.
					bush.
7	English, A. R.	Kukerin ...	Kukerin ...	Bencubbin ...	41
7	Kay, W. H. & F. C. ...	Lake Grace...	Lake Grace...	Gluclub ...	38
7	Bairstow, F.	Moulyinning	Kukerin ...	do. ...	38
8	Aylmore, A. E.	Gnowangerup	Gnowangerup	Nabawa ...	37
7	Bahr, O. E.	Merilup ...	Kukerin ...	Yandilla King	37
8	Garnett, V.	Gnowangerup	Gnowangerup	Bencubbin ...	36
8	Cockram, C. E.	do.	do.	Gallipoli ...	35
8	Dalton, J.	Wickepin ...	Wickepin ...	Bencubbin ...	35
8	Brooks, A. W.	East Narrogin	Royal ...	do. ...	34
9	Daw, F. E.	Ravensthorpe	Phillips River	Gluclub ...	33
8	McDonald, J. V. & A. R.	Gnowangerup	Gnowangerup	Bencubbin ...	33
8	Stewart, W. B.	Borden ...	do.	do. ...	33
8	Lloyd, C. J.	Toodyay ...	Royal ...	Nabawa ...	33
8	Boyle, T. K.	Greenhills ...	do. ...	Dundee ...	33
8	Richards, A.	South Caroling	do. ...	Totadgin ...	33
7	Morris, P.	Moulyinning	Kukerin ...	Gluclub ...	33
8	Beeck, N. H.	Broomehill ...	Royal ...	Gallipoli ...	32
8	Taylor, C.	do.	do. ...	Bencubbin ...	32
8	Burgess, W. G.	Burges Siding	do. ...	do. ...	32
7	Carruthers, R. (jun.) ...	Lake Grace...	Lake Grace...	Gluclub ...	32
1	Catta, G.	Carnamah ...	Carnamah ...	Ford ...	32
8	Boyle, K. C.	York ...	Royal ...	Merredin ...	31
7	Gray, J. S.	Kulin ...	Kulin ...	Gluclub ...	31
7	English, J. C.	Merilup ...	Kukerin ...	Bencubbin ...	31
7	Faulkner, W. J. ...	North Kukerin	do. ...	do. ...	31
7	Stubbs, W.	Kondinin ...	Kulin ...	do. ...	31
7	Darby, A. H.	Lake Grace...	Lake Grace...	do. ...	31
7	Biggin, H.	Kondinin ...	Kulin ...	Totadgin ...	31
1	Hockridge, W. J. ...	Moora ...	Royal ...	Sword ...	31
7	Clayton, R. & Sons ...	Jitarning ...	Kulin ...	do. ...	30
3	Ackland, H.	Wongan Hills	Ballidu ...	Bencubbin ...	30
1	Lynch, P. J.	Three Springs	Three Springs	do. ...	30
1	Clark, R. W.	Carnamah ...	Carnamah ...	Sutton ...	30

THE COMPOSITION OF SOME GRASSES FROM TUREE CREEK STATION OF THE NORTH-WEST PASTORAL AREA OF WESTERN AUSTRALIA.

A. B. Beck[1] and E. J. Underwood[2].

A matter of considerable economic importance to Western Australia is a more accurate knowledge of the stock-carrying capacity of the North-West pastoral areas. Such information concerning the pastoral areas of Australia as is at present available has come almost entirely from a process of trial and error, a process that is not only costly and slow but in some cases leads to such serious consequences as permanent injury to the grazing from denudation following overstocking. Although accurate information must ultimately come from controlled experiments in the areas concerned, yet much information may be obtained by a systematic chemical examination of the pastures of those areas. Little or no analytical work had been done on the pastures of the North-West, so during 1933 and 1934 arrangements were made for the regular collection of a number of grasses from Turee Creek Station in the upper Ashburton Valley. This station is situated about 200 miles north of Meekatharra just south of the tropic of Capricorn. About 70 samples were collected at various times of the year and were submitted to the Government Botanist (Mr. C. A. Gardner) for classification. From these, thirty-one of the more important species were selected and submitted to the Government Chemical Laboratory for analysis. These analyses are now complete and are submitted with all available data for the information of those interested and to supplement any future investigations of the pastures of this area.

Results.—The results of the chemical analyses, together with brief descriptions of the samples as received, are presented in the following tables. A point that should be noted is that except where qualified by a note in the description of the samples, the analyses refer to the whole plants. The moisture figures are for the air dry grass, as received. All other figures have been calculated to a moisture free basis.

Aristida stipoides (Wind Grass).

Date sample taken	1933.				1934.		
	June.	July.	Aug.	Sept.	Feb.	Mar.	Apl.
Moisture (as received) ...	7·55	7·85	7·95	7·85	7·90	7·15	7·60
Crude Protein (N x 6·25)	3·2	3·7	3·8	3·1	6·6	6·2	6·2
Ether Extract	0·6	0·6	0·5	0·3	0·5	0·9	0·8
Crude Fibre	38·7	37·8	40·4	39·2	39·2	40·7	44·1
N Free Extract	47·5	47·1	46·4	48·5	43·0	40·6	39·3
Total Ash	10·0	10·8	8·9	8·9	10·7	11·6	9·6
Calcium (CaO)	0·31	0·25	0·42	0·31	0·42	0·28	0·52
Phosphorus (P_2O_5) ...	0·34	0·48	0·30	Trace	0·69	Trace	0·39
Chlorine (Cl)	0·40	0·27	0·29	0·25	0·31	0·26	0·31
Silica	8·5	9·6	7·7	8·1	8·6	10·4	7·3

Analyst—F. W. Steel.

[1] Acting Animal Nutrition Officer.

[2] Animal Nutrition Officer.

1933—

June ... ... Dry wiry grass. Many seed heads.

July ... ... About 9in. tall. Mostly dry but contained a little green. Dry seed heads contained some seed.

August ... ... 6in. to 9in. tall. Similar to previous sample.

September ... Practically all dry. A few half-green stems and leaves. Contains some whole plants cut close to ground. Carries seed heads, grain partially shed.

1934—

February ... About 9in. in height. Mostly green with seed heads containing seed.

March ... ... 6in. to 9in. high. Mostly dry, with some seed heads, grain partially shed.

April ... ... About 9in. Partly green with seed heads, grain partially shed.

Astrebla pectinata (Mitchell Grass).

Sample taken	1933.		1934.
	June.	July.	February.
Moisture (as received)	7·81	8·56	8·79
Crude Protein (N x 6·25)	3·5	4·4	8·9
Ether Extract	0·5	0·5	0·2
Crude Fibre	29·4	28·8	30·2
N Free Extract	54·0	51·8	48·1
Total Ash	12·6	14·5	12·6
Calcium (CaO)	0·24	0·25	0·36
Phosphorus (P_2O_5)	0·23	0·23	0·27
Chlorine (Cl)	0·20	0·20	0·73
Silica	10·4	10·3	9·5

Analyst—F. W. Steel.

1933—

June ... ... About 12in. high. Partly green leaves and stems. Very few seed heads.

July ... ... Mostly green leaves and stems. 9in. to 12in. Some mature stalks removed from sample. Very few seed heads.

1934—

February ... Mostly green with green heads and seeds.

Chrysopogon Gryllus (Weeping Grass).

Sample taken ...	1933.				1934.		
	June.	Aug.	Sept.	Dec.	Jan.	Feb.	Mar.
Moisture (as received) ...	6·70	5·85	6·44	6·87	6·21	6·66	6·71
Crude Protein (N x 6·25)	4·1	4·9	3·9	1·8	6·3	4·0	7·9
Ether Extract	0·8	0·6	1·2	0·9	1·3	0·6	0·5
Crude Fibre	32·2	31·9	31·6	36·6	35·9	35·5	37·4
N Free Extract	46·5	52·2	49·4	50·0	44·7	46·3	43·9
Total Ash	16·4	10·4	13·9	10·7	11·8	13·6	10·3
Calcium (CaO)	0·39	0·77	0·48	0·24	0·25	0·19	0·63
Phosphorus (P_2O_5) ...	0·46	0·25	0·44	0·21	0·41	0·32	0·71
Chlorine (Cl)	0·26	0·22	0·20	0·23	0·26	0·22	0·55
Silica	9·3	7·6	11·9	9·5	9·9	12·8	5·5

Analyst—F. W. Steel.

1933—
June ... ... 15in. to 18in. high. Bottom half of grass dry and brown. Probably mature. Top 8in. to 9in. green leaf and stem. No flowering heads. Few inches of dry stem at bottom clipped off from sample.
August ... ... Tall grass 15in. high. Mostly green leaf and stem, but contains some tall dry pieces with partly green stem. No flowering heads in green portion, but dry portion has some dry seed heads containing no seed.
September ... Tall grass 18in. to 24in. Mostly green with full flowering heads. Some dry pieces removed.
December ... Tall dry grass with some seed heads. Seed partially shed.
1934—
January ... Tall grass 18in. to 20in. Mostly green, with green flowering heads.
February ... Tall grass 18in. Mostly green leaves and stems, with almost dry seed heads containing seed.
March ... ... 18in. to 20in. Half-green with some seed heads. Seed partially shed. Some dead stems removed from sample.

Eragrostis Brownii (Crabhole (Claypan ?) Grass).

Sample taken	1933. July.	1933. Aug.	1933. Sept.	1933. Dec.	1934. Mar.
Moisture (as received)	7·93	7·48	7·87	8·22	8·30
Crude Protein (N x 6·25) ...	4·1	3·8	3·3	3·2	11·7
Ether Extract	0·1	0·2	0·2	0·1	0·1
Crude Fibre	31·4	31·6	32·2	32·3	33·9
N Free Extract	53·0	50·0	51·0	55·0	43·0
Total Ash	11·4	14·4	13·3	9·4	11·3
Calcium (CaO)	0·34	0·34	0·31	0·48	0·48
Phosphorus (P_2O_5)	0·02	0·14	0·07	Trace	0·34
Chlorine (Cl)	0·09	0·12	0·10	0·12	0·36
Silica	10·3	13·0	11·8	7·6	7·9

Analyst—F. W. Steel.

1933—
July ... ... About 9in. tall. Mostly dry with a few green stems and leaves near base. Contains some empty seed heads.
August ... ... Mostly green but contains some dry leaves and stems.
September ... Mostly green with green flowering heads. 9in. to 12in. high.
December ... Dry grass 12in. tall with empty seed heads. No green stalks or leaves.
1934—
March ... ... Mostly green, 9in. in height. Contains seed heads with seeds.

Iseilema membranacea (Flinders Grass).

Sample taken	1934. March.
Moisture (as received)	8·11
Crude Protein (N x 6·25)	1·0
Ether extract	Trace
Crude fibre	36·1
N Free extract	50·0
Total ash	12·9
Calcium (CaO)	0·38
Phosphorus (P_2O_5)	0·55
Chlorine (Cl)	0·19
Silica	9·4

Analyst—F. W. Steel.

Small plants about 9in. high : mostly green, some seed heads with seeds.

Themeda triandra (Kangaroo Grass).

Sample taken ...	1933.					1934.		
	June.	July.	Aug.	Sept.	Dec.	Feb.	Mar.	Apl
Moisture (as received) ...	6·67	4·56	7·19	8·00	8·05	10·33	8·41	8·34
Crude Protein (N×6·25)	2·7	2·8	3·2	4·1	2·4	4·1	3·7	4·2
Ether Extract	1·6	1·2	1·8	1·4	0·7	1·4	1·1	0·9
Crude Fibre	35·1	33·9	34·3	32·9	34·8	35·6	34·2	35·3
N Free Extract	49·5	51·1	46·6	47·2	52·9	47·8	45·4	40·7
Total Ash	11·1	11·0	14·1	14·4	9·2	11·1	15·6	18·9
Calcium (CaO)	0·24	0·21	0·24	0·48	0·32	0·31	0·27	0·57
Phosphorus (P_2O_5) ...	0·27	0·27	0·25	0·16	0·05	0·25	0·07	0·25
Chlorine (Cl)	0·23	0·31	0·21	0·30	0·16	0·41	0·28	0·26
Silica	9·1	9·1	12·3	12·6	7·6	9·2	14·1	13·6

Analyst—F. W. Steel.

1933—

June ... ... Partly green leaves. Many dry flowering heads.

July ... ... Tall plants 18in. to 20in. Dry at top, green leaves and stems at bottom. Some dry seed heads containing seed.

August ... ... Tall plants 15in. to 18in. Dry stalks and leaves with green leaves 9in. long.

September ... Tall plants, half-green, half-dry. A number of old dead pieces of stalk removed from sample analysed.

December ... Tall dry grass, containing empty seed heads.

1934—

February ... Partly green leaves and stems with seed heads containing seed. 18in. to 20in. in height.

March ... ... Tall grass 20in. to 24in. Mainly dry stems and leaves. Seed partially shed.

April ... ... Tall dry grass, dry flowering heads. Seed partially shed.

The rainfall for the period during which the grasses were collected is given in the following table:—

Rainfall Record—Turee Creek, W.A., January, 1933, to June, 1934.

1933—	Jan.	Feb.	March.	April.	May.	June.	
Rainfall (points) ...	10	5	300	88	123	5	
Days of rain	1	1	10	4	4	1	
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Rainfall (points) ...	83	105	11	0	0	87	817
Days of rain	1	3	1	0	0	3	29
1934—	Jan.	Feb.	March.	April.	May.	June.	
Rainfall (points) ...	236	139	560	158	10	16	
Days of rain	5	5	11	7	1	1	

Discussion.

A consideration of the analyses shows several outstanding points. Though the total ash is high, silica is the predominating constituent. The only other available figures for this type of pasture are those for some grasses of Meteor Downs, Central Queensland. (H. R. Marston, C.S.I.R. Bulletin 61, 1932); these, too, show a high ash figure and a high proportion of silica. The grasses from Turee Creek tend to be quite low in both calcium and phosphorus. The low calcium figures are in marked contrast to high values found in pastures of the wheat belt areas. (1). This difference may possibly be correlated with a difference of the calcium status of the soils of the two areas.

A marked feature of the analyses is the low protein content of many of the samples though there is a definite increase in the protein content of the Weeping, Wind, Mitchell and Crabhole grasses and to a lesser extent of the Kangaroo Grass, during the months of February, March and April of 1934. This is almost certainly due to the growth of young shoots induced by rain that fell during this period.

The high fibre content of the grasses places it on a level with straw rather than pasture herbage with respect to this constituent. The analyses of various straws are given in the following table for comparison; the figures have all been calculated to a moisture free basis:—

Analysis of Straw Samples.

Type.	Source.	Reference.	Moisture.	Crude Protein.	Ether Extract.	Ash.	Crude Fibre.	Nitrogen free Extract.
Oaten ...	Meckering, W.A.	1	7·4	1·5	1·8	3·7	33·0	60·0
Oaten ...	Chapman, W.A.	1	10·7	1·4	2·0	6·6	39·9	50·1
Oaten ...	South Australia*	2	10·3	1·0	0·7	6·6	41·6	50·1
Wheaten	Victoria ...	3	11·0	4·6	1·6	7·1	32·7	54·0
Oaten ...	Victoria ...	3	11·0	2·5	1·8	6·9	34·8	54·0
Barley ...	Victoria ...	3	10·0	3·9	1·7	6·5	40·8	47·1

* Average 13 samples, 1923.

Although the fibre content of the Turee Creek grasses is high, it is considerably lower than that of the grasses from Meteor Downs.

A discussion of the feeding value of the grasses from a consideration of the analyses is not easy owing to a lack of other data. There is the difficulty of knowing how far the sample analysed represents the material actually consumed by the grazing animal. Cattle only are run at Turee Creek; these would be much less selective than sheep in their grazing, but it is probable that they will tend to leave the more fibrous stalks, and so consume a product rather more nutritious than the sample analysed (i.e., the whole plant). No digestibility figures for this type of feed are available but it is probable that, from the high fibre figures, the herbage will be of a low digestibility.

A comparison of the analyses with those of standard feeding stuffs indicates that, of the lower fibre (29-34%) grasses (Mitchell and Crabhole grass), when the protein is low (3-4%), the quality approximates to that of poor quality wheaten hay, but in periods of high protein (9-12%) the grasses will have a much higher feeding value. At the other end of the range, we have wind grass of high fibre content (38-44%); when the protein of this grass is low, the composition is similar to that of oaten straw and would be expected to have a very low feeding value. The samples of higher protein content (6-7%) will have a slightly greater feeding value but even at the best it is probably a very poor feeding stuff. In the North this grass is apparently considered as of very little value as a feed, a conclusion which is strongly supported by the analyses. Between these extremes we have the weeping grass of intermediate fibre content (32-37%) and a variable protein content (2-8%). Flinders grass and Kangaroo grass have similar fibre content but are characterised by very low protein figures (1-4%)—a fact which suggests a very small feeding value with respect to this constituent. Flinders grass, however, is considered a valuable grass and it is not safe to draw any conclusions as to its feeding value from one analysis only. The high fibre and

low protein content of almost all the grasses examined suggests that at least in certain periods of the year the likelihood of a protein deficiency in the grazing is very great.

REFERENCES.

1. E. J. Underwood and F. L. Shier, Journal W.A. Department of Agriculture, December, 1937, p. 442.
2. Department of Agriculture, Western Australia (unpublished data).
3. S.A. Journal of Agriculture, January, 1925, 28 (6) 527.
4. Victorian Journal of Agriculture, December, 1936, 631.

LOCAL CROP COMPETITIONS.

I. THOMAS, Superintendent of Wheat Farming.

In addition to the 50-acre crop competitions conducted by the Royal and District Agricultural Societies under the Zone system several separate competitions have been conducted.

The Bruce Rock Agricultural Society and the Koorda Agricultural Society each conducted a Fallow and Crop Competition.

The competition for the Bevan Trophy was continued for another year in the Wialki district under the control of the local branch of the Wheat Growers' Union.

The Kirwan Agricultural Bureau conducted a 50-acre crop competition under the same conditions as govern the Royal Agricultural Society's competition though not affiliated with it.

The particulars of the respective competitions are as follow:—

BRUCE ROCK AGRICULTURAL SOCIETY.

Fallow and Crop Competition.

Judges: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser—Fallow section; W. M. Nunn, B.Sc. (Agric.), Agricultural Adviser—Crop section.

The rainfall recorded at Bruce Rock for 1937 is shown below:—

					Growing Period.								Total for
	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Year.
Bruce Rock	4	9	47	61	223	144	45	231	49	37	729	154	4	1,008

KOORDA AGRICULTURAL SOCIETY.

Fallow and Crop Competition.

Judge: W. M. Nunn, B.Sc. (Agric.), Agricultural Adviser.

The rainfall recorded at Koorda, Booralaming and Cowcowing is shown below.

					Growing Period.								Total for
	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Year.
Koorda	59	7	48	30	215	112	28	232	73	31	691	66	*Nil*	901
Booralaming	30	10	12	42	252	187	26	190	58	21	734	76	*Nil*	904
Cowcowing	50	*Nil*	35	28	223	154	33	197	57	27	691	24	*Nil*	828

The judges' awards are shown in the following tables:—

BRUCE ROCK AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.	Fallow Competition Total.	Total for Fallow and Crop Competition. 200 pts.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.	100 pts.	
Pimlott, S. H.	Kwolyin	Totadgin	18	8	9	14	13	62	86	148
Ellis, E. G. & M. P.	Ardath	Bencubbin	19	8	9	12	10	58	85	143
Boase, E. M.	Bruce Rock	Totadgin	15	9	9	14	10	57	85	142
Buller, A. M.	do.	Gluclub	17	7	8	12	10	54	86	140
Fuchsbichler, M.	do.	Bencubbin	11	8	9	12	10	50	86	136

KOORDA AGRICULTURAL SOCIETY.

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.	Fallow Competition Total.	Total for Fallow and Crop Competition 200 pts.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.	100 pts.	
Best, R. T.	Booralaming, *via* Dowerin	Bencubbin	17	7	9	14	14	61	79	140
Sharman, H.	do.	Totadgin	16	8	9	14	14	61	73	134
Lehmann & Richardson	Dukin	Bencubbin	15	8	9	13	11	56	80	145

THE BEVAN TROPHY.

Judge: W. M. Nunn, B.Sc. (Agric.), Agricultural Adviser.

The competition for this trophy donated by Mr. A. W. Bevan for competition in the Wialki-Bonnie Rock area was this year conducted under the direction of the Wialki branch of the Wheat Growers' Union. Conditions governing the competition were the same as those governing the Royal Agricultural Society's Competitions.

The rainfall recorded at Wialki, North Wialki, Moondon, and South Wialki is shown below.

	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Wialki	74	14	37	42	155	28	16	216	70	28	513	44	....	824
North Wialki	80	11	60	34	134	171	22	168	46	26	567	87	5	844
Moondon	60	25	40	29	150	169	14	223	49	22	627	80	....	801
South Wialki	57	15	33	36	89	130	15	190	44	12	480	(not available)		

The judge's awards are set out in the following table:—

Competitor.	Address.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
			50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Miguel, J. A.	Wialki	Noongaar	13	9	9	14	14	59
Bratt, H. L.	do.	Bencubbin	14	8	8	14	13	57
Vincent, K. A. M.	do.	do.	13	8	9	13	13	56
Klie, W.	do.	do.	12	7	9	14	13	55
Chamberlain, J.	do.	do.	11	8	9	14	13	55
Clark, J. & W. M.	do.	do.	11	8	9	14	13	55
Barwise, P. J.	do.	do.	10	8	9	14	14	55
Matthews, G. H.	do.	do.	11	8	9	13	12	53
Goff, G. (sen.)	do.	do.	11	7	9	12	13	52
Willox, J. G.	do.	Gluyas Early	9	6	9	13	12	49
Styler, F. W.	do.	Bencubbin	10	8	9	10	11	48
Greig, W. W.	do.	Noongaar	8	6	9	12	10	45
Arnold, J. G.	do.	Carrabin	7	6	9	14	8	44

KIRWAN AGRICULTURAL BUREAU.

Judge: R. P. Roberts, B.Sc. (Agric.) Hons., Agricultural Adviser.

Rains recorded at Burakin and at Kokardine are shown below:—

	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
Burakin	54	4	55	36	253	178	36	256	45	28	796	122	*	*
Kokardine	*Nil*	*Nil*	89	50	239	203	38	245	90	28	843	111	3	1,096

* Not available.

The judge's awards are set out in the following table:—

Competitor.	Variety.	Yield.	Freedom from Weeds.	Freedom from Disease.	Freedom from Admixture.	Evenness of Growth.	Total.
		50 pts.	10 pts.	10 pts.	15 pts.	15 pts.	100 pts.
Strahan, E. F.	Bencubbin	24	9	9	12	14	68
Mitchell, H.	do.	23	8	9	13	12	65
Mitchell, J. A.	do.	19	9	9	13	13	63
Joynes, W.	do.	17	8	9	12	13	59
Montague, J.	Totadgin	18	7	9	12	12	58
Joynes, G.	Merredin	19	8	8	11	12	58
Strahan Bros.	Bencubbin	15	8	9	12	13	57
Flavell, R.	do.	17	8	8	10	11	54
Broadhurst, Mrs. H. A.	do.	14	6	9	9	11	49

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1937, AT THE AGRICULTURAL RESEARCH STATIONS.

I. Thomas,
Superintendent of Wheat Farming.

At each of the Research Stations located in the Wheat Belt, field experiments with wheat and oats are conducted each year. These Research Stations are widely separated and embrace a considerable variation of soil and climatic conditions.

The field experiments conducted cover a wide range and include such important phases as fallowing, depth and time of ploughing and frequency of cultivation. The most prolific varieties, the best time to plant, the most economical rates of seed and superphosphate to apply, and the effect of various fungicides upon the yields are ascertained.

With but one or two minor exceptions the experimental plots are one eighth of an acre in area. They are long and narrow, being one drill width wide, and measure 833 links by 15 links, and are replicated five times.

They are designed on the "three plot" system, the centre plot of each section (three plots) being the control—thus each varying factor is adjacent to a control plot.

The results of the Chapman, Dampawah, Merredin, Salmon Gums and Yilgarn Research Stations are given, but unfortunately the experiments at the Wongan Hills Research Station were destroyed by a very severe hail storm before they were harvested.

MERREDIN RESEARCH STATION.

J. H. Langfield, Farm Manager.

This station is located 160 miles from Perth on the Eastern Goldfields Railway and is approximately in the centre of the main Eastern Wheat Belt. The major portion of the land is salmon gum and gimlet forest country.

The following table shows the monthly rainfalls as recorded at the Station during 1937, together with the average rainfall for the past 26 years:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
1937	25	6	31	31	206	164	37	169	47	28	651	96	6	846
Av., 26 years	49	44	101	87	129	176	175	152	82	78	792	39	51	1,163

The first four months were very dry during which period only 94 points of rain fell. This following a very dry year in 1936, when only 881 points were registered, left the subsoil almost depleted of moisture. The seasonal rains commenced on 17th May and conditions for early growth were very favourable, but a prolonged dry spell during July and early August however seriously affected the growth of the crops. Good rains late in August revived them, but owing to a lack of finishing rains the yields obtained did not reach earlier expectations.

The cultural details with the exception of the Fallow *v.* Non Fallow, Time of Ploughing and Mulching Experiments were as follow:—

The land on which the plots were planted was ploughed in early July, 1936, with a disc plough to a depth of 3½-4 ins. It was cultivated with a rigid tyne scarifier in September, 1936, and again with the tandem disc harrows just prior to seeding.

FALLOW V. NON-FALLOW.

The object of this experiment is to ascertain the effect of fallowing upon the grain yield of the subsequent wheat crop.

The fallowed plots were ploughed 3-4 inches deep in mid June, 1936, with a disc plough, scarified in August, 1936, and cultivated with a disc cultivator prior to seeding, whilst the non-fallowed plots were ploughed 27th May, 1937, with a disc plough and cultivated with a disc cultivator before seeding.

FALLOW *v* NON-FALLOW EXPERIMENT.

Planted on 2nd June, 1937. Superphosphate—112lbs. per acre.
Germinated on 16th June, 1937. Variety—Noongaar. Seed—45lbs. per acre.

Treatment.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1925–37.	Percentage Yields. % 1925–37.
Non-fallow	12 8	100	15 44	100
Fallow	16 32	136	21 52	139

The results for this and previous years show the definite advantage to be obtained from planting the wheat crop on fallowed land.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, i.e. ploughing, has any effect upon the yield of the resulting wheat crop.

The land for this experiment was ploughed in three sections during 1936; one in March, another in June (the control) and the third in August. Each section was cultivated with a rigid tyne scarifier in September, 1936, and prior to seeding with the tandem disc harrows.

TIME OF PLOUGHING EXPERIMENT.

Planted on 2nd June, 1937. Superphosphate—112lbs. per acre.
Germinated on 16th June, 1937. Variety—Noongaar. Seed—45lbs. per acre.

Treatment. (Ploughed 1936.)	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1930–37.	Percentage Yields. % 1930–37.
Mid-July	15 4	92	25 20	93
Mid-June	16 24	100	27 4	100
Mid-August	15 28	94	21 12	78

The results for 1937 and the average for those of the previous years show that higher yields are obtained when the land is fallowed in the early winter months rather than in the late winter or early spring.

MULCHING EXPERIMENT.

The object of this experiment, which has been conducted since 1915, is to determine to what extent and under what conditions the cultivation of winter fallowed land is profitable during the spring and summer.

To meet the requirements of the experiment three plots were treated, as follows:—

Plot 1.—Cultivated prior to seeding only (neglected fallow).
Plot 2.—Cultivated during spring and prior to seeding (ordinary fallow).
Plot 3.—Cultivated during spring, again when required during summer after 25 points of rain or over, and again prior to seeding.

Plot No. 1 was cultivated with tandem disc harrows prior to seeding only.

Plot No. 2 was cultivated on 21st September, 1936, with a springtyne implement and prior to seeding using a tandem disc.

Plot No. 3 was cultivated on 21st September, 1936, and the 27th December, 1936, with a springtyne cultivator and again prior to seeding using a tandem disc harrow.

All plots were ploughed in July, 1936.

MULCHING EXPERIMENT, 1937.

Planted on 12th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 24th May, 1937. Variety—Totadgin. Seed—45lbs. per acre.

Treatment.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1915–37.*	Percentage Yields. % 1915–37.*
Mulched before planting only ...	16 24	103	20 0	95
Mulched in spring and before planting	15 52	100	21 4	100
Mulched in spring, after rain during summer, and before planting	16 0	101	21 28	102

* 1936 excluded.

This year's results and the results of the previous years indicate that payable increases in yield do not result from summer cultivation. However in some years special circumstances, such as the setting of the soil after excessive rain and heavy weed growth which cannot be controlled by stock, necessitate these cultivations.

TIME OF PLANTING EXPERIMENT.

The object of this experiment is to determine the most suitable month to plant the wheat crop.

To meet the requirements of this experiment the midseason maturing variety Nabawa was planted in mid April, May and June, while Gluyas Early, an early maturing variety, was sown in mid May, June and July.

TIME OF PLANTING EXPERIMENT, 1937.

Superphosphate—112lbs. per acre. Variety—Nabawa. Seed—45lbs. per acre.

Date planted.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.*	Percentage Yields. % 1929–37.*
15th April	10 48	111	22 0	107
15th May	9 44	100	20 32	100
15th June	6 16	64	16 16	79

* 1936 excluded.

TIME OF PLANTING EXPERIMENT, 1937.

Superphosphate—112lbs. per acre. Variety—Gluyas Early. Seed—45lbs. per acre.

Date planted.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1923–37.*	Percentage Yields. % 1923–37.*
15th June	9 4	80	21 4	92
15th May	11 20	100	22 56	100
15th July	2 48	25	12 40	55

* 1936 excluded.

These results and experience elsewhere in the Eastern Wheat Belt indicate that the planting of a midseason variety should in general not extend beyond the middle of May, and the early variety after the end of May.

RATE OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most economical rate of seed with:—

(a) A mid-season free-stooling variety;

(b) An early sparse-stooling variety.

To meet these requirements, the variety Nabawa was used in the first case, and the variety Noongaar in the second, and each was sown at the rate of 30, 45 and 60 lbs. of seed per acre.

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 7th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 24th May, 1937. Variety—Nabawa.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1913–37.	Percentage Yields. % 1913–37.
30lbs.	15 12	98	18 40	94
45lbs.	15 28	100	19 52	100
60lbs.	14 40	95	19 52	100

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 1st June, 1937. Superphosphate—112lbs. per acre.
Germinated on 16th June, 1937. Variety—Noongaar.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1915–37.	Percentage Yields. % 1915–37.
30lbs.	13 36	97	18 8	96
45lbs.	14 0	100	18 56	100
60lbs.	14 0	100	18 56	100

The results for both sections show that there is no advantage in sowing more than 45 lbs. of seed per acre.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to ascertain the most profitable rate of superphosphate to apply to the wheat crop.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, 1937.

No. 1.

Planted on 11th May, 1937. Germinated on 25th May, 1937. Variety—Totadgin.
Seed—45 lbs. per acre.

Rate of Application of Superphosphate per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.*	Percentage Yields. % 1929–37.*
Nil	8 24	59	13 4	57
150lbs.	14 16	100	22 48	100
75lbs.	14 0	98	20 48	91

* 1936 excluded.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, 1937.

No. 2.

Planted on 11th May, 1937. Germinated on 25th May, 1937. Variety—Totadgin. Seed—45lbs. per acre.

Rate of Application of Superphosphate per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1929–37.*	Percentage Yields. % 1929–37.*
300lbs.	15 52	97	24 24	105
150lbs.	16 24	100	23 20	100
225lbs.	15 44	96	24 8	103

* 1936 excluded.

This year's results and the averages for the past seven years indicate that the rate of superphosphate can be increased with advantage above 75 lbs. per acre. The most economical rate on this class of soil under present conditions would be about 90-100 lbs. per acre.

POTASH-NITROGEN EXPERIMENT.

The object of this experiment is to determine the effect upon the wheat crop of the application of—

(a) A nitrogenous fertiliser;

(b) A nitrogenous plus a potassic fertiliser.

Sulphate of ammonia, a nitrogenous fertiliser, and sulphate of potash, a potassic fertiliser, were used in addition to superphosphate.

The results obtained are given below:—

POTASH-NITROGEN EXPERIMENT, 1937.

Planted on 25th May, 1937. Germinated on 4th June, 1937. Variety—Totadgin. Seed—45lbs. per acre.

Rate of Fertiliser per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.	Percentage Yields. % 1932–37.
1 cwt. Superphosphate; 1 cwt. Sulphate of Ammonia	14 0	100	20 8	102
1 cwt. Superphosphate	14 0	100	19 44	100
1 cwt. Superphosphate; 1 cwt. Sulphate of Ammonia; 1 cwt. Sulphate of Potash	13 44	98	19 52	101

The results for this and previous years show that the application of a potassic or nitrogenous fertiliser in addition to superphosphate leads to no increase in yields.

SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

(a) To ascertain the most suitable month to plant the late, mid-season, early, and very early maturing varieties of wheat; and

(b) To determine the most prolific of each of the above types.

To meet the requirements of the experiments three sections were needed, viz.:—

(a) Section 1, planted in April—Representing early planting.

(b) Section 2, planted in May—Representing mid-season planting.

(c) Section 3, planted in June—Representing late planting.

In all sections the standard mid-season maturing variety Nabawa was planted in the control plots.

SEASONAL PLANTING EXPERIMENT, 1937.

APRIL PLANTING.

Planted on 15th April, 1937. Superphosphate—112lbs. per acre.
Germinated on 24th May, 1937. Seed—45lbs. per acre.

Variety.	Average Yields per acre. bus. lb.	Percentage Yields. %	Average Yields per acre. bus. lb.	Percentage Yields. %
	1937.	1937.		1929–37.*
Bencubbin	10 24	113	...	112
Nabawa	9 12	100	...	100
Totadgin	10 24	113	...	93†

* 1936 excluded. † 1930–31–37.

SEASONAL PLANTING EXPERIMENT, 1937.

MAY PLANTING.

Planted on 15th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd June, 1937. Seed—45lbs. per acre.

Variety.	Average Yields per acre. bus. lb.	Percentage Yields. %	Average Yields per acre. bus. lb.	Percentage Yields. %
	1937.	1937.		
Bencubbin	9 28	118	...	112*
Nabawa	8 0	100	...	100*
M 44	7 12	92	...	...†
Gluyas Early	9 44	122	...	109‡
Nabawa	8 0	100	...	100†
M 58	10 0	125	...	...†
Totadgin	8 48	114	...	118§
Nabawa	7 44	100	...	100§
M 45	7 28	97	...	...†
M 47	6 56	96	...	...†
Nabawa	7 12	100	...	100†
M 51	7 20	102	...	...†
M 52	8 0	113	...	...†
Nabawa	7 4	100	...	100†
M 53	7 44	109	...	...†
M 54	7 44	108	...	...†
Nabawa	7 12	100	...	100‡
Noongaar	8 8	113	...	102‡

* 1929–37 with 1936 excluded. † 1937 only. ‡ 1928–37 with 1936 excluded.
§ 1931–37 with 1936 excluded.

SEASONAL PLANTING EXPERIMENT, 1937.

JUNE PLANTING.

Planted on 15th June, 1937. Superphosphate—112lbs. per acre.
Germinated on 2nd July, 1937. Seed—45lbs. per acre.

Variety.	Average Yields per acre. bus. lb.	Percentage Yields. %	Average Yields per acre. bus. lbs.	Percentage Yields. %
	1937.	1937.		
Bencubbin	3 28	108	...	112†
Nabawa	3 12	100	...	100†
M 58	6 32	204	...	...§
Gluyas Early	5 36	183	...	112*
Nabawa	3 4	100	...	100*
Totadgin	5 28	178	...	119‡
Geeralying	4 48	120	...	99*
Nabawa	4 0	100	...	100*
Noongaar	6 48	170	...	118*

* 1928–37 with 1936 excluded. † 1930–37 with 1936 excluded. ‡ 1931–37 with 1936 excluded. § 1937 only.

In the April section this year the varieties Bencubbin and Totadgin gave similar yields. The average results, however, show that the mid-season maturing variety Bencubbin is the most suitable for planting in April.

In the section planted in May, M.58, Gluyas Early, Bencubbin, Totadgin, M.52 and Noongaar yielded well. In the average results the varieties Totadgin, Bencubbin and Gluyas Early have proved most suitable for planting in May.

The yields of the whole of the June section are very low, owing to late germination and the adverse season, and show that the yields are very considerably reduced by planting in June. The new crossbred M.58 was outstanding in the June section and also gave the highest yield in the May section.

OAT VARIETY TRIALS.

The object of this experiment is to ascertain the grain yielding capacity of several varieties of oats.

The varieties under test were Mulga, Guyra and Wongan. The latter is a new crossbred (Burt's Early x Mulga) which was produced at the Wongan Hills Research Station. This variety is approximately a week earlier, and is shorter in the straw than either of its parents.

OAT VARIETY TRIAL.

Planted on 3rd May, 1937. Superphosphate—112lbs. per acre.
Germinated on 28th May, 1937. Seed—40lbs. per acre.

Variety.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb.	Percentage Yields. % 1931–37.*
Mulga	18 32	100	...	100
Guyra	19 32	105	...	98
Wongan	18 32	96	...	...
Mulga	19 24	100	...	100

* Excluding 1935 and 1936.

There is no significant difference between the yields of the different varieties. The yields however, in view of the adverse growing season, can be considered satisfactory, and indicate the suitability of the varieties for districts of low rainfall.

FUNGICIDE EXPERIMENT.

The object of this experiment is to determine the effect upon the germination, growth and grain yields of a finely powdered organic mercury compound and copper carbonate, when used as a fungicide for wheat and oats.

Plots were sown with seed treated with an organic mercury compound and with Copper Carbonate, at the rate of two ounces per bushel and compared with control plots of untreated seed. No difference could be noticed regarding germination and growth during the year. The results obtained are as follow:—

FUNGICIDE EXPERIMENT, 1937.

Wheat.

Planted on 8th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 24th May, 1937. Variety—Totadgin. Seed—45lbs. per acre.

Treated with—	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb.	Percentage Yields. %
A Mercury Compound	5 4	109	...	..
Untreated	4 40	100	...	...
Copper Carbonate	4 56	106	...	

FUNGICIDE EXPERIMENT, 1937.

Oats.

Planted on 8th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 24th May, 1937. Variety—Mulga. Seed—36lbs. per acre.

Treated with—	Average Yields per acre. bus. lb.	Percentage Yields. %	Average Yields per acre. bus. lb.	Percentage Yields. %
	1937.	1937.		
A Mercury Compound	11 24	89	...	...
Untreated	13 0	100	...	...
Copper Carbonate	12 8	94	...	...

This is the second year that the experiment has been conducted. The results in 1936, however, were affected by drought conditions. In 1937 slight increases were obtained from the use of each of the fungicides for wheat. With the oats there was a decrease in yield.

The results are for one year only and further results are necessary before definite conclusions may be drawn.

CHAPMAN RESEARCH STATION.

F. Gishubl,
Farm Manager.

The Chapman Research Station is situated on the Upper Chapman River, 28 miles north of Geraldton and 334 miles by rail from Perth. The land on the station is mostly typical jam timber country with a little York gum running into lighter timbered country.

The following table shows the monthly rainfall as recorded at the Station during 1937, and the average rainfall for the past 32 years—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
1937	4	17	2	84	333	539	37	306	156	46	1,417	26	11	1,561
Av., 32 years	28	40	75	67	240	425	378	280	156	93	1,572	31	24	1,837

Owing to the good May rains the crop was planted in a moist seed bed and made good growth until checked by the dry spell experienced in July. Only 37 points fell between 28th June and 6th August, during which period eleven frosts and frequent hot, drying winds were experienced. However, good rains fell during the remainder of August and September and the crops made a very good recovery.

The land on which the experiments were planted originally carried York gum, jam and wattle. It has been under cultivation for many years. After several years grazing it was fallowed in 1934, cropped 1935 and fallowed again in 1936.

With the exception of the Fallow *v.* Non-Fallow experiment, the cultural details of the experiments are as follow:—

The land was ploughed with a mouldboard plough to a depth of 4 inches in June-July, 1936, cultivated with a springtyne cultivator in early September, 1936, early May, 1937, and prior to seeding which was done with a disc drill. The land at the time of seeding was clean and in good condition.

FALLOW V. NON-FALLOW EXPERIMENT.

The object of this experiment is to ascertain the effect of fallowing upon the subsequent wheat crop.

The fallowed plots were ploughed in July, 1936, with a mouldboard plough and springtyne cultivated in September, 1936, March, 1937, and twice in May,

1937, whilst the non-fallowed plots were ploughed in May, 1937, with a mouldboard plough and springtyne cultivated and seeded the following day.

The results are as follow:—

FALLOW *v.* NON-FALLOW EXPERIMENT.

Planted on 26th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 30th May, 1937. Variety—Nabawa. Seed—60lbs. per acre.

Treatment.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.	Percentage Yields. % 1929–37.
Fallow	24 24	161	16 24	124
Non-fallow	15 12	100	13 12	100

The fallowed plots withstood the dry spell in July much better than the non-fallowed and at maturity they were 6-8 inches higher and denser. Although not entirely free from weeds the fallowed plots had far less weed competition than the non-fallowed plots, which suffered badly, due to doublegees and other weeds coming away at the same time as the wheat.

The results for this and previous years are distinctly in favour of fallowing for wheatgrowing.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to ascertain the most economical rate of superphosphate to apply to the wheat crop.

The results are tabulated below:—

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, 1937.

Planted on 21st May, 1937. Germinated on 28th May, 1937. Variety—Nabawa.
Seed—60lbs. per acre.

Rate of Application of Superphosphate per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.	Percentage Yields. % 1929–37.
Nil	11 36	91	10 56	80
150lbs.	12 48	100	13 36	100
75lbs.	12 32	98	12 32	92

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, 1937.

Planted on 21st May, 1937. Germinated on 28th May, 1937. Variety—Nabawa.
Seed—60 lbs. per acre.

Rate of Application of Superphosphate per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1929–37.	Percentage Yields. % 1929–37.
300lbs.	13 28	113	13 52	106
150lbs.	11 52	100	13 4	100
225lbs.	13 32	105	13 20	102

This year's results and those of the previous eight years indicate that the rate of superphosphate can be increased with advantage above 75 lbs. per acre and that the most economical rate under present conditions is approximately 100 lbs. per acre.

POTASH-NITROGEN EXPERIMENT.

The object of this experiment is to determine the effect upon the grain yield of the subsequent wheat crop of the application of:—

(a) A nitrogenous fertiliser.

(b) A nitrogenous fertiliser plus a potassic fertiliser.

In addition to the usual application of superphosphate, sulphate of ammonia, a nitrogenous fertiliser, and sulphate of potash, a potassic fertiliser, were used.

The results are as follow:—

NITROGEN-POTASH EXPERIMENT, 1937.

Planted on 24th May, 1937. Germinated on 29th May, 1937. Variety—Nabawa.
Seed—60 lbs. per acre.

Rate of Application of Fertiliser per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.	Percentage Yields. % 1932–37.
1 cwt. Superphosphate; 1 cwt. Sulphate of Ammonia	26 48	103	15 28	106
1 cwt. Superphosphate	26 0	100	14 32	100
1 cwt. Superphosphate; 1 cwt. Sulphate of Ammonia; 56 lbs. Sulphate of Potash	26 40	103	15 44	108

The results show that slight increases in yields are obtained by the application of a nitrogenous fertiliser (in addition to superphosphate) but no further increase results from the use of a potassic fertiliser in addition. The increases are not sufficient to warrant the expenditure incurred. It is felt that the nitrogen level and the general fertility of these soils could be materially improved by pasture improvement, utilising leguminous crops such as lupins, first early subterranean clover, etc., during the grazing years.

RATE OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most economic rate of seeding for:—

(a) A mid-season, free stooling variety;

(b) An early, sparse stooling variety.

The variety Nabawa was used in the former case, whilst S.H.J. was used in the latter.

The results are as follow:—

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 22nd May, 1937. Superphosphate—112lbs. per acre.
Germinated on 28th May, 1937. Variety—Nabawa.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1923–37.*	Percentage Yields. % 1923–37.*
45lbs.	24 16	100	14 32	100
60lbs.	24 24	101	14 56	103
90lbs.	25 28	105	15 52	109

* 1932 excluded.

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 22nd May, 1937. Superphosphate—112lbs. per acre.
Germinated on 28th May, 1937. Variety—S.H.J.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1923–37.	Percentage Yields. % 1923–37.*
60lbs.	15 12	109	16 16	107
45lbs.	14 0	100	15 12	100
90lbs.	17 36	126	16 56	111

* 1932 excluded.

Both this year's and average results for the period of the experiment are in favour of the heavier rates of seeding, particularly with the early or sparse stooling variety. Where competition from weeds is likely to occur, 60 lbs. for the mid-season variety and probably higher for the early maturing variety could be used with advantage.

FUNGICIDE EXPERIMENT.

The object of this experiment is to determine the effect upon the germination, growth and grain yield of a finely powdered organic mercury compound and copper carbonate when used as fungicides for wheat.

FUNGICIDE EXPERIMENT, 1937.

Planted on 22nd May, 1937. Superphosphate—112lbs. per acre.
Germinated on 28th May, 1937. Variety—Nabawa. Seed—60lbs. per acre.

Seed Pickled with—	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1936–37.	Percentage Yields. % 1936–37.
A Mercury Compound	18 48	105	16 32	103
No treatment	17 52	100	16 0	100
Copper Carbonate	19 12	107	16 40	104

The results for 1937 and the average results for the two years the experiment has been conducted indicate that slight increases in yield are obtained from the use of these fungicides, although no difference could be detected either in the germination or growth of the treated plots. Further experiments will be necessary before definite conclusions may be drawn.

YILGARN RESEARCH STATION.

W. A. HUMAN,
Farm Manager.

The Yilgarn Research Station is situated on the eastern fringe of our present defined wheat-growing area. This station, which is adjacent to Ghooli siding, eight miles east of Southern Cross, on the Eastern Goldfields railway, was established in December, 1926, and was officially opened in May, 1928.

The following table shows the monthly rainfalls as recorded at the station during 1937, together with the average rainfall for the past nine years:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
1937	32	6	293	48	73	138	43	143	35	30	462	141	14	996
Av., 9 years, 1928–36	48	45	68	107	144	137	128	153	50	75	687	54	51	1,060

The rainfall for the growing period, 462 points, was the lowest on record. There was a general absence of good soaking rains throughout this period. A fall of 210 points in March materially assisted to carry the crop through the prolonged dry spell experienced during July and early August.

The land on which these experiments were conducted was originally timbered with salmon gum and gimlet, and was previously cropped in 1935.

Excepting where the requirements of an experiment required other working, the cultural details of all experiments were as follow:—

The plots were ploughed with a disc-cultivating plough to a depth of 3-4 inches in July, 1936, cultivated with a rigid tyne cultivator in August, 1936, and spring-tyne cultivated in March, 1937, after heavy rain, and again prior to seeding. The seed was sown on a moist seed bed.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yield of the resulting wheat crop.

The land for this experiment was ploughed in three sections during 1936; one was ploughed in March, another in June (the control), and the third in August. Each section was cultivated in August, 1936, with a rigid tyne cultivator, during March, 1937, after a heavy rain and prior to seeding, with a spring-tyne implement. The March-ploughed plots produced greater weed growth in the following autumn. At the time of planting all the plots were in good condition.

TIME OF PLOUGHING EXPERIMENT, 1937.

Planted on 24th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Variety—Gluyas Early. Seed—40lbs. per acre.

Time of Ploughing.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1929–37.*	Percentage Yields. % 1929–37.*
March	9 4	105	10 32	93
June	8 40	100	11 20	100
August	10 8	117	10 56	96

* 1930, 1931, 1932 and 1936 excluded.

The average results from this experiment for the years in which it has been conducted show that the initial operation of fallowing is best carried out during the early winter.

DEPTH OF PLOUGHING EXPERIMENT.

The object of this experiment is to determine the most economical depth to plough when fallowing for the wheat crop.

DEPTH OF PLOUGHING EXPERIMENT, 1937.

Planted on 24th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Variety—Gluyas Early. Seed—40lbs. per acre.

Depth of Ploughing.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1933–37.*	Percentage Yields. % 1933–37.*
2in.	10 8	106	11 52	100
4in.	9 36	100	11 52	100
6in.	10 8	100	11 52	100

* 1934 and 1936 excluded.

This year's results show a slight but insignificant increase in yield for the 2in. deep section, but the average results for the period of the experiment (1933-37) show no difference between any of the sections. However, it is found that the plots ploughed to a depth of 2 inches require additional cultivation to maintain the mulch and provide a satisfactory seed-bed and, in view of this, it is more economical to plough to a depth of 4 inches.

MULCHING EXPERIMENT.

The object of this experiment is to determine to what extent and under what conditions the cultivation of winter fallowed land is profitable during the spring and summer.

To meet the requirements of the experiment, three plots were treated, as follows:—

Plot 1.—Cultivated prior to seeding only (neglected fallow).

Plot 2.—Cultivated during spring and prior to seeding (ordinary fallow).

Plot 3.—Cultivated during spring, again when required during summer after 25 points of rain or over, and again prior to seeding.

All plots were ploughed in July, 1936.

Plot 1 was spring-tyne cultivated in August, 1936, November, 1936, and December, 1936, March, 1937, and prior to seeding.

Plot 2 was cultivated in August, 1937, and prior to seeding.

MULCHING EXPERIMENT, 1937.

Planted on 25th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Variety—Gluyas Early. Seed—40lbs. per acre.

When Cultivated.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1928–37.*	Percentage Yields. % 1928–37.*
Before seeding only	8 56	103	11 44	98
In spring and before seeding ...	8 40	100	12 0	100
In spring, after summer rains, and before seeding	9 12	106	12 32	104

* 1936 excluded.

This year's results and the average results for nine years indicate that while slight increases in yield may result from spring and summer cultivation, these increases are not economical.

TIME OF PLANTING EXPERIMENT.

The object of this experiment is to determine the most suitable month to plant the wheat crop.

To meet the requirement of this experiment, two varieties of different maturity were used, Nabawa representing the mid-season varieties and Gluyas Early the early-maturing varieties.

TIME OF PLANTING EXPERIMENT, 1937.

Superphosphate—112lbs. per acre. Variety—Nabawa. Seed—40lbs. per acre.

Date Planted.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.*	Percentage Yields. % 1929–37.*
April 17th	10 40	154	17 28	106
May 18th	6 56	100	16 32	100
June 16th	7 36	110	10 32	63

* 1936 excluded.

TIME OF PLANTING EXPERIMENT, 1937.

Planted on 18th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Variety—Gluyas Early. Seed—40lbs. per acre.

Date Planted.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1929–37.*	Percentage Yields. % 1929–37.*
May 18th	9 4	100	17 4	100
June 16th	9 44	107	12 32	73
July 15th	Destroyed by grasshoppers.			

* 1936 excluded.

The May and June plantings in both the Nabawa and Gluyas Early germinated practically together on 3rd July, and hence the results this year are of little value. The average results, however, indicate that the best returns are obtained by planting the mid-season variety Nabawa during the last two weeks in April and the early variety, Gluyas Early, early in May. Yields are considerably reduced if planting is extended into June. During the last three years the July seeding has been destroyed by grasshoppers and indicates that July seeding is definitely unsuitable.

RATE OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most economic rate of seeding with—

(a) a mid-season, free-stooling variety;
(b) an early, sparse-stooling variety.

To meet these requirements, the variety Nabawa in the former and the variety Noongaar in the latter were used, and each was sown at the rate of 30, 45 and 60 lbs. of seed per acre.

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 17th April, 1937. Superphosphate—112lbs. per acre.
Germinated on 26th April, 1937. Variety—Nabawa.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. *	Percentage Yields. % *
30lbs.	6 32	92	...	...
45lbs.	7 4	100	...	...
60lbs.	6 56	98	...	...

*Average not available as this is first year of rates of seeding 30, 45 and 60 lbs. per acre.

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 27th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Variety—Noongaar.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. *	Percentage Yields. % *
30lbs.	6 40	98	...	...
45lbs.	6 48	100	...	...
60lbs.	6 48	100	...	...

*Average not available as this is first year of rates of seeding 30, 45 and 60 lbs. per acre.

Previous to this season the rate of seeding in this experiment were 20, 30 and 40 lbs. per acre. Over a period of years the rate of 20 lbs. proved to be too light; therefore it was decided to alter the rates to 30, 45 and 60 lbs. per acre.

In the results this year there is practically no difference in the yields from the different rates of seeding, with either the varieties Nabawa or Noongaar. The average results in the past indicate that for both the free and sparse stooling varieties up to 40 lbs. of seed can be sown to advantage.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to ascertain the most profitable rate of superphosphate to apply to the wheat crop.

The results obtained are as follows:—

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, 1937.

No. 1

Planted on 21st May, 1937. Germinated on 3rd July, 1937. Seed—40lbs. per acre. Variety—Gluyas Early.

Rate of Application of Superphosphate per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.*	Percentage Yields. % 1929–37.*
Nil	4 40	44	9 36	55
150lbs.	10 40	100	17 20	100
75lbs.	7 52	74	14 24	83

* 1936 excluded.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT, 1937.

No 2

Planted on 21st May, 1937. Germinated on 3rd July, 1937. Seed—40lbs. per acre. Variety—Gluyas Early.

Rate of Application of Superphosphate per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs. 1929–37.*	Percentage Yields. % 1929–37.*
225lbs.	10 48	109	15 52	102
150lbs.	9 52	100	15 36	100
300lbs.	10 32	107	16 0	103

* 1932 and 1936 excluded.

This year's results, and those for the previous years, indicate that increased yields are obtained by applications of superphosphate up to 300 lbs. per acre. The economical rate, however, would be in the vicinity of 100 lbs. per acre.

POTASH-NITROGEN EXPERIMENT.

The object of this experiment is to determine the effect upon the yield of the wheat crop of the application of—

(a) a nitrogenous fertiliser;

(b) a nitrogenous plus a potassic fertiliser.

To meet the requirements of this experiment, sulphate of ammonia, a nitrogenous fertiliser, and sulphate of potash, a potassic fertiliser, were used in addition to superphosphate

POTASH-NITROGEN EXPERIMENT, 1937.

Planted on 21st May, 1937. Germinated on 3rd July, 1937. Seed—40lbs. per acre.
Variety—Gluyas Early.

Treatment.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1933–37.*	1933–37.*
1 cwt. Superphosphate; 1 cwt. Sulphate of Ammonia	7 52	97	14 0	98
1 cwt. Superphosphate	8 8	100	14 16	100
1 cwt. Superphosphate; 1 cwt. Sulphate of Ammonia; 56lbs. Muriate of Potash	7 44	95	13 52	97

* 1936 excluded.

The results for 1937 are in agreement with the results of previous years, in demonstrating that increased yields cannot be expected following the application of a nitrogenous or a nitrogenous plus a potassic fertiliser in addition to superphosphate.

SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

(a) To ascertain the most suitable month to plant the late, mid-season, early and very early maturing varieties of wheat; and

(b) To determine the most prolific of each of the above types.

To meet the requirements of the experiments, three sections were needed, viz.:—

(a) Section 1, planted in April, representing early planting.

(b) Section 2, planted in May, representing mid-season planting.

(c) Section 3, planted in June, representing late planting.

In all sections the standard mid-season maturing variety Nabawa was planted in the control plots.

SEASONAL PLANTING EXPERIMENT, 1937.

APRIL PLANTING.

Planted on 16th April, 1937. Superphosphate—112lbs. per acre.
Germinated on 26th April 1937. Seed—40lbs. per acre.

Variety.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1932–37.*	1932–37.*
Noongaar	6 32	55	10 56	70
Gluyas Early	11 52	100	15 36	100
Totadgin	10 24	88	15 52	102
Bencubbin	14 32	122	17 20	112
Gluyas Early	11 52	100	15 28	100
Nabawa	12 32	106	16 0	103

* 1936 included.

SEASONAL PLANTING EXPERIMENT, 1937.

May Planting.

Planted on 17th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Seed—40lbs per acre

Variety.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.*	Percentage Yields. % 1932–37.*
Noongaar	10 40	93	13 36	84
Gluyas Early	11 28	100	16 16	100
Geeralying	10 8	88	13 52	85
Merredin	11 28	101	15 44	98
Gluyas Early	11 20	100	16 8	100
Totadgin	10 24	92	16 40	103
S.H.J.	10 32	90	13 36	84
Gluyas Early	11 44	100	16 8	100
Carrabin	9 36	82	14 32	90
Bencubbin	12 8	105	17 36	112
Gluyas Early	11 36	100	15 44	100
Nabawa	10 40	92	15 44	100

* 1936 excluded.

SEASONAL PLANTING EXPERIMENT, 1937.

June Planting.

Planted on 15th June, 1937. Superphosphate—112lbs. per acre.
Germinated on 3rd July, 1937. Seed—40lbs. per acre.

Variety.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.*	Percentage Yields. % 1932–37.*
Noongaar	6 8	85	11 36	100
Gluyas Early	7 12	100	11 36	100
Geeralying	4 56	69	9 52	85
Merredin	5 20	71	10 56	95
Gluyas Early	7 28	100	11 28	100
Totadgin	7 28	100	12 16	107
S.H.J.	5 36	72	9 20	77
Gluyas Early	7 44	100	12 8	100
Carrabin	5 28	71	10 16	85
Bencubbin	6 48	91	13 20	111
Gluyas Early	7 28	100	12 0	100
Nabawa	5 36	75	11 44	98

* 1936 excluded.

In the April section the mid-season variety Bencubbin has given the best results both in 1937 and in the previous four years. The original growth of "Noongaar," a very early maturing variety, was destroyed by frost, and the yield obtained was produced by a second growth.

The May and June sections germinated together on 3rd July, and in consequence there is no significant difference in the results for 1937. The average results for the previous four years indicate that the variety Bencubbin is the most suitable one for April sowing and that Bencubbin, Totadgin, Gluyas Early and Noongaar are most suitable for sowing in that order of planting in May. The yields are considerably decreased by drought conditions where planting is carried out in June, and consequently the only conclusion which can be drawn from this section is that sowing should not be continued into this month in these areas.

FUNGICIDE EXPERIMENT.

The object of this experiment is to determine the effect upon the germination, growth and grain yield of a finely powdered organic mercury compound and copper carbonate when used as a fungicide for wheat.

FUNGICIDE EXPERIMENT, 1937.

Planted on 15th May, 1937. Superphosphate—112lbs. per acre.
Germinated on 24th May, 1937. Variety—Totadgin. Seed—40lbs. per acre.

Treated with—	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.		
A Mercury Compound	9 28	99	...	...
Untreated	9 36	100	...	...
Copper Carbonate	9 28	99	...	...

The results in 1936 were discarded owing to seasonal conditions. In 1937 no difference could be observed regarding germination and growth, and there was no significant difference in the yield of the treated and untreated plots. Further trials will be necessary before definite conclusions may be drawn.

DAMPAWAH RESEARCH STATION.

F. A. NEWMAN,
Farm Manager.

The Dampawah Research Station is situated on the southern fringe of the Lower Murchison and the eastern edge of the northern wheat belt, and is approximately 30 miles east of Perenjori. The soil is a red friable loam, uniform in appearance, and was originally timbered with York gum, giant mallee, karara and mulga scrub.

The following table shows the monthly rainfalls as recorded at the station during 1937, together with the average rainfall for the past seven years:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
1937	66	27	24	61	134	333	8	129	37	40	668	27	....	873
Av., 1929-36	63	51	122	72	151	224	157	163	55	40	790	65	40	1,203

The season opened on 14th May, when 35 points of rain fell in two days. This was followed by a further 89 points in two falls two days later. From that time until 8th June no further rain fell. All crops sown up till 20th May germinated evenly. The rainfall for June was extremely good, 333 points being registered in seven falls. Although many frosts, followed by warm days, were then experienced, the crops made good growth up till the middle of July, when 8 points fell, the only rain registered during that month. From then onwards, however, until the end of the third week in August, conditions were very unfavourable and the crops failed to make any growth owing to the cold, dry conditions.

The prolonged dry spell which had lasted nearly eight weeks was relieved by a fall of 22 points of rain on 18th August. From then on until the end of the month further rains fell totalling 129 points. These extremely useful rains materially improved the outlook. Only 37 points fell in September and 27 in October and were of little benefit.

The land on which the experiments were conducted was originally timbered with York gum, giant mallee, mulga, and karara scrub, and was cleared in 1927. It was first cropped in 1929 on fallow and then grazed in 1930, fallowed in 1931, cropped 1932, grazed 1933, fallowed 1934, cropped 1935, fallowed 1936 and cropped again this year.

Excepting where the requirements of the experiments demanded otherwise, the cultural details of the experiments were as follows:—Ploughed with a disc cultivating plough in late June, 1936, cultivated in September, 1936, with a spring-tyne cultivator, and owing to the absence of weeds received no further cultivation. All the plots were sown with a combined cultivator drill.

FALLOW v. NON-FALLOW EXPERIMENT.

The object of this experiment is to ascertain the effect of winter fallowing on the subsequent wheat crop.

The fallowed plots were ploughed in late June, 1936, with a disc cultivating plough to a depth of 3-4 inches and spring-tyne cultivated in September, 1936.

The non-fallowed plots were ploughed in a dry condition in early April, 1937, with a disc cultivating plough. The results obtained are as follows:—

FALLOW *v.* NON-FALLOW EXPERIMENT, 1937.

Planted on 3rd May, 1937. Superphosphate—90lbs. per acre.
Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Treatment.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1930–37.*	Percentage Yields. % 1930–37.*
Fallow	14 32	107	15 4	118
Non-fallow	13 36	100	12 48	100

* 1936 excluded.

The results this year and the average results also, although to a greater extent, indicate that the yields are increased when the land is fallowed for the wheat crop.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yield of the resultant wheat crop.

The results are as hereunder:—

TIME OF PLOUGHING EXPERIMENT, 1937.

Planted on 3rd May, 1937. Superphosphate—90lbs. per acre.
Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

When Ploughed.	Average Yields per acre. bus. lb. 1937	Percentage Yields. % 1937	Average Yields per acre. bus. lb. 1930–37.*	Percentage Yields. % 1930–37.*
March, 1936	11 4	94	10 32	72
June, 1936	11 44	100	14 40	100
August, 1936	11 44	100	14 16	97

* 1936 excluded.

The average results over the past seven years show that the initial operation of fallowing is best carried out during the early winter months.

DEPTH OF PLOUGHING EXPERIMENT.

The object of this experiment is to ascertain the most economical depth to plough when fallowing for the wheat crop.

DEPTH OF PLOUGHING EXPERIMENT, 1937.

Planted on 3rd May, 1937. Superphosphate—90lbs. per acre.
Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Depth Ploughed.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1930–37.*	1930–37.*
2in.	9 20	86	13 28	91
4in.	10 48	100	14 48	100
6in.	10 52	101	14 32	98

* 1936 excluded.

The results indicate that it is most economical to plough to a depth of 4 inches. In addition to a lower yield being obtained from the plot ploughed 2 inches deep, it was found necessary for it to receive extra cultivation to maintain the desired tilth.

MULCHING EXPERIMENT.

The object of this experiment is to ascertain to what extent and under what conditions the cultivation of winter fallowed land is profitable during the spring and summer months.

To meet the requirements of the experiment, 3 plots were treated as follows:—

Plot 1.—Cultivated prior to seeding only (neglected fallow).

Plot 2.—Cultivated during spring and prior to seeding (ordinary fallow).

Plot 3.—Cultivated during spring when required during summer, i.e. after 25 points of rain or more, and again prior to seeding.

This year Plot 3 was cultivated on August 24th, 1936, October 1st, 1936, November 26th, 1936, January 13th, 1937, and prior to seeding, while Plot 2 was cultivated on August 24th, 1936, and prior to seeding.

MULCHING EXPERIMENT, 1937.

Planted on 4th May, 1937. Superphosphate—90lbs. per acre.
Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Treatment.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lbs.	%
	1937.	1937.	1929–37.*	1929–37.*
Cultivated before seeding only ...	13 12	112	15 44	100
Cultivated in spring and before seeding	11 44	100	15 44	100
Cultivated in spring, after summer rain, and before seeding	10 48	92	15 44	100

* 1936 excluded.

The average results over a period of this experiment indicate that there is no advantage to be gained by spring or summer cultivations, whilst the results of last year's experiments indicate that these cultivations may have a deleterious effect. These experiments and general experience at this and other stations have

shown that the fallow should only be cultivated when special circumstances warrant it, such as after excessive rain which may cause the land to set hard or produce a heavy weed growth which cannot be controlled by stock. Spring and summer cultivation is likely to destroy the consolidation and seed bed in light types of soil and so have a depressing effect on the yield. Autumn cultivation after rains is necessary, of course, particularly where weeds are expected.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to determine the most economical rate to apply superphosphate to the wheat crop.

RATE OF SUPERPHOSPHATE EXPERIMENT, 1937.

Section 1.

Planted on 4th May, 1937. Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Rate of Superphosphate per Acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1929–37.*	1929–37.*
Nil	5 20	47	6 56	42
150lbs.	11 28	100	16 40	100
75lbs.	10 0	87	14 98	89

* 1930 and 1936 excluded.

RATE OF SUPERPHOSPHATE EXPERIMENT, 1937.

Section 2.

Planted on 4th May, 1937. Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Rate of Superphosphate per Acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1929–37.*	1929–37.*
225lbs.	10 16	96	16 24	102
150lbs.	10 40	100	16 8	100
300lbs.	10 0	94	16 32	102

* 1930 and 1936 excluded.

This year's results and those of previous years indicate that the rate of application of superphosphate can be increased with advantage above 75 lbs. per acre and that the most economical rate on this class of country under present conditions would be approximately 100 lbs. per acre.

POTASH-NITROGEN EXPERIMENT.

The object of this experiment is to determine the effect upon the grain yield of the wheat crop from the application of:—

(a) A nitrogenous fertiliser.

(b) A nitrogenous fertiliser + a potassic fertiliser when used in conjunction with superphosphate.

Sulphate of ammonia, a nitrogenous fertiliser, and sulphate of potash, a potassic fertiliser, were used in addition to superphosphate. The results were as follows:—

POTASH-NITROGEN EXPERIMENT, 1937.

Planted on 11th May, 1937. Germinated on 18th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Rate of Fertiliser per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.	Percentage Yields. % 1932–37.
1 cwt. superphosphate; 1 cwt. sulphate of ammonia	10 8	97	14 48	100
1 cwt. superphosphate	10 24	100	14 48	100
1 cwt. superphosphate · 1 cwt. sulphate of ammonia, 1 cwt. potash	9 52	95	14 48	100

The average results since the inception of this experiment show that no increase in yield follows the application of these fertilisers in addition to superphosphate.

RATE OF SEEDING EXPERIMENT.

The object of this experiment is to ascertain the most economical rate of seeding with:—

(a) A mid-season free stooling variety.

(b) An early sparse stooling variety.

To meet these requirements the variety Bencubbin was used in the first case and Noongaar in the second.

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 1st May, 1937. Superphosphate—90lbs. per acre.
Germinated on 18th May, 1937. Variety—Bencubbin.

Rate of Seed per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1929–37.*	Percentage Yields. % 1929–37.*
30lbs.	9 36	90	13 36	103
45lbs.	10 40	100	13 12	100
60lbs.	10 40	100	13 4	99

* 1936 excluded.

RATE OF SEEDING EXPERIMENT, 1937.

Planted on 22nd May, 1937. Superphosphate—90lbs. per acre.
Germinated on 26th May, 1937. Variety—Noongaar.

Rate of Seeding per Acre.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1931–37.*	Percentage Yields. % 1931–37.*
30lbs.	9 12	98	15 20	96
45lbs.	9 20	100	16 8	100
60lbs.	9 36	103	16 8	100

* 1936 excluded.

The average results indicate that there is no advantage in sowing at a greater rate than 30 lbs. of graded seed per acre for the mid-season free stooling variety Bencubbin or more than 45 lbs. per acre for the early sparse stooling variety Noongaar.

TIME OF PLANTING EXPERIMENT.

The object of this experiment is to determine the most suitable month in which to plant an early and a very early maturing wheat variety.

Two varieties were used, the early variety Gluyas Early, planted in April, May and June, and the very early variety Noongaar, planted in May, June and July.

TIME OF PLANTING EXPERIMENT, 1937.

Superphosphate—90lbs. per acre. Variety—Gluyas Early. Seed—45lbs. per acre.

Planted on—	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.*	Percentage Yields. % 1932–37.*
15th April	8 24	78	13 44	95
13th May	10 48	100	14 32	100
15th June	6 8	57	8 8	56

* 1936 excluded.

TIME OF PLANTING EXPERIMENT, 1937.

Superphosphate—90lbs. per acre. Variety—Noongaar. Seed—45lbs. per acre.

Planted on—	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lb. 1932–37.*	Percentage Yields. % 1932–37.*
16th June	10 32	103	14 0	91
17th May	10 16	100	15 28	100
15th July	2 8	21	5 12	34

* 1936 excluded.

The results for this year and average results for the four previous years indicate that May is the best month to sow the wheat crop.

SEASONAL PLANTING EXPERIMENT.

The objects of this experiment are:—

(a) To ascertain the most suitable month to plant the mid-season, early and very early maturing varieties of wheat;

(b) To determine the most prolific of each of the above types.

To meet the requirements of the experiment, three sections were planted, viz.:—

(a) Section 1, planted in April, representing early planting.

(b) Section 2, planted in May, representing mid-season planting.

(c) Section 3, planted in June, representing late planting.

SEASONAL PLANTING EXPERIMENT, 1937.

APRIL PLANTING.

Planted on 16th April, 1937. Superphosphate—90 lbs. per acre.
Germinated on 20th April, 1937. Seed—45 lbs. per acre.

Variety.	Average Yields per acre. bus. lb. 1937.	Percentage Yields. % 1937.	Average Yields per acre. bus. lbs.	Percentage Yields. % 1931–37.*
Bencubbin	7 44	100	...	103
Gluyas Early	7 44	100	...	100
Nabawa	6 16	81	...	87
Totadgin	6 56	95	...	100†
Gluyas Early	7 20	100	...	100
Carrabin	5 28	75	...	86
Merredin	6 32	84	...	97
Gluyas Early	7 44	100	...	100
Noongaar	5 36	72	...	85

* 1935–36 excluded. † 1932–37.

May Planting.

Planted on 14th May, 1937. Superphosphate—90lbs. per acre.
Germinated on 18th May, 1937. Seed—45lbs. per acre.

Variety.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937	1937		1931–37.*
Merredin	6 8	81	...	93
Gluyas Early	7 36	100	...	100
S.H.J.	5 4	67	...	74
Bencubbin	9 36	113	...	103
Gluyas Early	8 32	100	...	100
Nabawa	8 16	97	...	83
Totadgin	7 36	93	...	101†
Gluyas Early	8 8	100	...	100
Carrabin	7 36	93	...	88
Geeralying	5 44	67	...	75
Gluyas Early	8 32	100	...	100
Noongaar	6 56	81	...	94

* 1936 excluded. † 1932–37.

June Planting.

Planted on 16th June, 1937. Superphosphate—90lbs. per acre.
Germinated on 21st June, 1937. Seed—45lb. per acre.

Variety.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937	1937		1931–37.*
Merredin	7 4	87	...	85
Gluyas Early	8 8	100	...	100
S.H.J.	8 8	100	...	99
Totadgin	7 44	100	...	97†
Gluyas Early	7 44	100	...	100
Bencubbin	6 24	83	...	72†
Geeralying	7 36	98	...	94
Gluyas Early	7 44	100	...	100
Noongaar	8 0	103	...	113

* 1936 excluded. † 1934–37.

In the April section, Bencubbin and Gluyas Early (the control) are the best yielders followed by Totadgin. From past experience there is a definite danger of loss through either frost or septoria in planting an early maturing variety in April; it is, therefore, recommended that the mid-season variety Bencubbin be planted during this month.

Bencubbin is again outstanding in the May section and in the average results is closely followed by Totadgin and Gluyas Early. In the June section Noongaar, a very early variety, has given best results for this and previous years and is recommended for the later half of May.

Experience and the results of these experiments emphasise the necessity for completing the seeding operations by the end of May. It is therefore recommended that for April planting the mid-season variety Bencubbin be used; for the first half of May the early varieties Gluyas Early and Totadgin and for the latter half, Noongaar.

FUNGICIDE EXPERIMENT.

The object of this experiment is to determine the effect upon the germination, growth and grain yield of the use of a finely powdered organic mercury compound and copper carbonate as fungicides for wheat.

The experiment was initiated in 1936, but on account of the seasonal conditions, the results were discarded.

FUNGICIDE EXPERIMENT, 1937.

Planted on 22nd May, 1937. Superphosphate—90lbs. per acre.
Germinated on 27th May, 1937. Variety—Noongaar. Seed—45lbs. per acre.

Treated with—	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.		
Mercury Compound	9 36	99	...	...
Seed untreated	9 44	100	...	...
Copper Carbonate	10 0	103	...	...

No difference could be detected regarding the germination and growth of any of the plots, and there was no significant difference in yield of the treated and untreated seed. Further experiments will be necessary before definite conclusions may be drawn.

SALMON GUMS RESEARCH STATION.

J. M. Moulton,
Farm Manager.

The monthly rainfalls as recorded at the Station during 1937, together with the average for the past 12 years, were as follow:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period. May.	June.	July.	Aug.	Sept.	Oct.	Total.	Nov.	Dec.	Total for Year.
1937	68	159	251	78	153	106	29	196	148	63	695	229	8	1,488
Av., 12 years	56	59	147	99	132	133	142	172	89	108	776	94	64	1,295

The rainfall for the greater part of the season was favourable for the growth of the crops. The heavy rains which fell in February and March facilitated the preparation of a good seed-bed in addition to assuring reserves of moisture in the subsoil. Seeding operations were carried out under ideal conditions and the germination was excellent.

The land on which the Rate of Superphosphate, Time of Seeding and Potash-Nitrogen experiments were planted was a red sandy loam typical of the more satisfactory wheat soils of the district.

This land, and also that on which the Kopi Experiments were planted, was ploughed with a disc cultivating plough in June and July, 1936, to a depth of 3-4 inches and springtyne cultivated immediately after ploughing. In August it was cultivated to the full depth with a rigid tyne cultivator and again after heavy rains in early January, February and March. Further cultivation with the same implement was given prior to seeding.

The land on which the Clay Soil Experiment was planted was ploughed during the first week in July, 1936, with a mouldboard plough to a depth of 3-4 inches, and was rigid tyne cultivated to the full depth of ploughing at the end of August.

after heavy rains in February and in mid April. After rain on 13th May it was springtyned cultivated and sown to further rain again before seeding.

TIME OF SEEDING EXPERIMENT.

The object of this experiment is to determine the most suitable month in which to plant the wheat crop. To meet the requirements of the experiment, a midseason maturing variety Bencubbin was planted in mid April, May and June, and an early maturing variety Gluyas Early in mid May, June and July.

TIME OF SEEDING EXPERIMENT.

Superphosphate—112lbs. per acre. Variety—Bencubbin. Seed—45lbs. per acre.

Date Planted.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1928–37.	1928–37.
19th April	9 36	64	13 4	97
18th May	14 56	100	13 28	100
15th June	11 28	77	9 44	72

TIME OF SEEDING EXPERIMENT.

Superphosphate—112lbs. per acre. Variety—Gluyas Early. Seed—45lbs. per acre.

Date Planted.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lbs.	%
	1937.	1937.	1928–37.	1928–37.
18th May	13 28	100	14 32	100
15th June	17 28	130	12 0	83
14th July	10 8	75	8 56	61

From the results in 1937, it would appear that May is the best month for planting the midseason variety Bencubbin. However, the difference in average yields between the April and May sown plots is not significant, and seeding with a midseason variety could, therefore, commence with safety about the middle of April. In 1937 the best yields were obtained by planting the early maturing variety Gluyas Early in June. However, the average results for nine years indicate that the yields are decreased when seeding extends after the end of May.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

The object of this experiment is to ascertain the most profitable rate of superphosphate to apply to the wheat crop.

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

No. 1.

Planted on 20th May, 1937. Germinated on 30th May, 1937. Variety—Gluyas Early. Seed—45lbs. per acre.

Rate of Application of Superphosphate per Acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1929–37.	1929–37.
Nil	9 36	62	6 56	45
150lbs.	15 28	100	15 28	100
75lbs.	13 20	86	13 28	87

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

No. 2.

Planted on 19th June, 1937. Germinated on 30th June, 1937. Variety—Gluyas Early.
Seed—45lbs. per acre.

Rate of Application of Superphosphate per Acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1929–37.	1929–37.
225lbs.	20 32	110	17 28	105
150lbs.	18 40	100	16 40	100
300lbs.	21 12	114	17 28	105

The results in 1937 and the averages for the past nine years indicate that the rate of superphosphate can be increased with advantage above 75 lbs. per acre. The most economical rate on this class of soil, under present conditions, would be about 90-100 lbs. per acre.

POTASH-NITROGEN EXPERIMENT.

The object of this experiment is to determine the effect upon the grain yield of the wheat crop of the application of—

(a) a nitrogenous fertiliser.

(b) a nitrogenous fertiliser plus a potassic fertiliser

in addition to the usual application of superphosphate.

Sulphate of Ammonia, a nitrogenous fertiliser, and Sulphate of Potash, a potassic fertiliser, were used.

POTASH-NITROGEN EXPERIMENT.

Planted on 18th May, 1937. Germinated on 30th May, 1937. Variety—Gluyas Early.
Seed—45lbs. per acre.

Rate of Application of Fertiliser per Acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1932–37.	1932–37.
112lbs. Superphosphate plus 112 lbs. Sulphate of Ammonia	10 24	108	14 0	101
112lbs. Superphosphate	9 36	100	13 52	100
112lbs. Superphosphate plus 56 lbs. Sulphate of Potash plus 112lbs. Sulphate of Ammonia	10 24	108	13 28	97

The results in 1937 show that a slight increase in yield is obtained by the application of the nitrogenous fertiliser, in addition to the superphosphate, but that no further increase results from the potassic fertiliser in addition.

The average results, however, for the nine years the experiment has been conducted indicate that no significant increase in the grain yield is obtained from the application of a nitrogenous and a potassic fertiliser in addition to superphosphate.

EXPERIMENTS ON "KOPI" SOILS.

Owing to the unsatisfactory crops of wheat generally obtained from the so-called "Kopi" soils in the Salmon Gums area, experiments have been conducted with a view of obtaining definite information regarding crop response on this class of soil. The original vegetation included giant mallee, a variety of *Eucalyptus oleosa*, and a member of the red morrel family.

The Salmon Gums "Kopi" is described as a light grey highly calcareous soil. It is fairly powdery and represents grey morrel soil of the Eastern Wheat Belt. With working it tends to become a little more compact.

OAT VARIETY TRIAL.

The object of this experiment is to ascertain the most suitable oat to plant on this type of soil.

OAT VARIETY TRIAL.

Planted on 19th April, 1937. Superphosphate—112lbs. per acre.
Germinated on 1st May, 1937. Seed—45lbs. per acre.

Variety.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1931–37.*	1931–37.*
Mulga	6 0	75	9 0	96
Algerian	7 32	100	9 32	100
Guyra	6 24	80	10 0	104

* 1934 excluded.

The result in 1937 was in favour of the late maturing variety Algerian. The average results for the six years the experiment has been conducted are slightly in favour of the midseason maturing variety Guyra.

MANURIAL EXPERIMENT.

To determine the effect on the grain yield of the wheat crop planted on this type of soil, when applications of heavy dressings of stable manure and also of a mixed fertiliser are made in addition to the usual application of superphosphate.

For the purpose of this experiment, three plots were required, and received the following applications of fertiliser—

Plot 1. 1 cwt. of superphosphate and 15 tons of stable manure per acre.

Plot 2. 1 cwt. of superphosphate per acre.

Plot 3. 1 cwt. of superphosphate and 120 lbs. per acre of mixed fertiliser consisting of Manganese Sulphate, Borax, Zinc Sulphate, Magnesium Sulphate, Copper Sulphate and Iron Sulphate. Thus each was applied at the rate of 20 lbs. per acre. This is the first year that the mixed fertiliser has been used, Manganese Sulphate at the rate of 56 lbs. per acre being previously used. There was, however, no significant increase in yield from the use of this fertiliser.

MANURIAL EXPERIMENT.

Planted on 20th May, 1937. Superphosphate—112lbs. per acre.
Variety—Gluyas Early. Seed—45lbs. per acre.

Rate of Application of Fertiliser per acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	bus. lb.	%	bus. lb.	%
	1937.	1937.	1932–37.	1932–37.
112lbs. Superphosphate plus 15 tons Stable Manure	11 52	210	10 32	186
112lbs. Superphosphate	5 36	100	5 44	100
112lbs. Superphosphate plus 120 lbs. Mixed Fertilisers	5 52	105	...	...

The results in 1937 confirm those of the previous six years that heavy dressings of stable manure, in addition to superphosphate, will definitely increase the grain yields. No significant increase in yield was obtained from the application of the mixed fertiliser.

FODDER TRIAL.

The object of this trial is to ascertain the relative yields of green fodder obtained from the common fodder plants when planted on this type of soil. Sulphate of ammonia at the rate of 1 cwt. per acre was applied to certain plots of Mulga oats and Wimmera rye grass to ascertain if this would increase the yield of fodder.

The yields of the green fodders were calculated by taking cuttings from quadrats of one square yard in area systematically through the respective plots.

The yields are shown hereunder.

FODDER EXPERIMENT—KOPI SOIL.

YIELD OF GREEN FODDER.

Planted on 20th April, 1937. Superphosphate—112lbs. per acre. Germinated on 1st May, 1937.

Fodder.	Rate of Seed per acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	lbs.	tons.	%	tons.	%
		1937.	1937.	1933–37.*	1933–37.*
Gluyas Early	45	0·47	54	0·66	62
Mulga Oats (Control)	40	0·87	100	1·07	100
Mulga Oats plus 1 cwt. Sulphate of Ammonia	40	0·89	103	1·18	110
Rye	40	0·89	117	1·60	168
Wimmera Rye Grass (control)	4	0·76	100	0·97	100
Wimmera Rye Grass plus 1 cwt. Sulphate of Ammonia	4	0·85	112	1·01	106

* 1934 excluded.

In 1937 almost similar yields were obtained from Rye, Mulga oats, and Mulga oats receiving an application of 1 cwt. of Sulphate of Ammonia per acre. Increased yields were also obtained from the Wimmera Rye Grass receiving an application of Sulphate of Ammonia. The average results for the four years the experiment has been conducted indicate that the best yield of green fodder is obtained from Rye and that the applications of 1 cwt. of Sulphate of Ammonia, in addition to superphosphate to Mulga oats and Wimmera Rye Grass has increased the green fodder yield.

FODDER EXPERIMENT.

The object of this experiment is to ascertain which of the cereals, wheat, oats and rye, gives the best grain yields on "Kopi" soils.

In addition to the usual application of 1 cwt. of superphosphate per acre, certain of the Mulga oats plots received an application of 1 cwt. of Sulphate of Ammonia per acre.

FODDER EXPERIMENT.

GRAIN YIELD.

Planted on 20th April, 1937. Superphosphate—112lbs. per acre. Germinated on 1st May, 1937.

Fodder.	Rate of Seed per acre.	Average Yields per acre.	Percentage Yields.	Average Yields per acre.	Percentage Yields.
	lbs.	tons.	%	tons.	%
		1937.		1935–37.	
Gluyas Early	45	157	75	408	202
Mulga Oats (Control)	40	208	100	202	100
Mulga Oats plus 1 cwt. Sulphate of Ammonia	40	251	121	206	102
Rye	40	181	87	282	140

Because of the difference in the bushel weight of the cereals the results are expressed in pounds instead of bushels. The yields from all cereals on this soil are low.

In 1937 the plots of Mulga oats receiving an application of 1 cwt. of sulphate of ammonia have given the best result. The average results for the three years the experiment has been conducted indicate that the highest yields are obtained from the early maturing wheat variety Gluyas Early. Rye has also yielded very well. They also show that increased yields of Mulga oats obtained from applications of sulphate of ammonia are not sufficient to warrant the extra cost of application.

FODDER EXPERIMENTS ON CLAY SOIL.

In addition to the experiments on "Kopi" soils, experiments were also conducted on the heavy clay soils.

The object of these experiments is to determine the most suitable crops either as grain or fodder crops on this type of soil under field conditions.

FODDER EXPERIMENT.

Yield of Green Fodder.

Planted on 17th May, 1937. Variety.	Superphosphate—112lbs. per acre. Rate of Seed per acre.	Average Yields per acre.	Percentage Yields.	Germinated on 27th May, 1937. Average Yields per acre.	Percentage Yields.
	lbs.	tons.	%	tons.	%
		1937.	1937.	1935–37.	1935–37.
Gluyas Early	45	1·44	110	1·27	115
Bencubbin (Control)	45	1·31	100	1·10	100
Atlas Barley	40	1·77	136	1·70	154
Mulga Oats	40	1·18	60	1·05	73
Rye (Control)	45	1·97	100	1·44	100
Wimmera Rye	6	1·31	67	1·00	69

In 1937 for fodder purposes Rye followed by Atlas barley, gave the best results. Over the three years the experiment has been conducted the Atlas barley has yielded to advantage.

Grain Yields.

Because of the difference in the bushel weights of the various cereals, the grain yields are shown in pounds instead of bushels. The results were as follow:—

FODDER EXPERIMENT.

Grain Yields.

Planted on 17th May, 1937. Fodder.	Superphosphate—112lbs. per acre. Rate of Seed per acre.	Average Yields per acre.	Percentage Yields.	Germinated on 24th May, 1937. Average Yields per acre.	Percentage Yields.
	lbs.	lbs.	%	lbs.	%
		1937.	1937.	1935–37.	1935–37.
Gluyas Early	45	765	77	592	97
Bencubbin (Control)	45	995	100	608	100
Atlas Barley	40	752	76	648	107
Mulga Oats	40	462	65	216	44
Rye (Control)	45	669	100	496	100
Wimmera Rye	6	101	15	....	....

In 1937 the midseason maturing wheat variety Bencubbin has given the highest grain yield. This has also yielded well over the three years the experiment has been conducted and is only slightly exceeded by Atlas barley.

POTATO FERTILISER TRIALS AT BUREKUP, 1937.

E. T. Morgan,
Officer in Charge, Potato Branch.

A new departure in fertiliser experiments with potatoes in this State, and possibly in the Commonwealth, was made at Burekup during the past season, where the trials were inaugurated to ascertain whether any effect or none was to be derived from the inclusion of certain minor elements in the fertiliser mixtures. These elements, as well as the layout of the trials, were suggested by Dr. L. J. H. Teakle, Plant Nutrition Officer of this Department and to whom I am indebted for the analyses of the figures tabulated.

The fertiliser treatments were:—

Treatment No.	Sulphate of Ammonia. Cwts. per acre.	Superphosphate. Cwts. per acre.	Sulphate of Potash. Cwts. per acre.
1	4	4	2
2	4	4	2
+ 20 lbs. each of Sulphates of Zinc, of Copper, of Manganese, and of Magnesium.			
3	4	12	2 (Control)
4	4	12	2
+ 20 lbs. each of Sulphates of Zinc, of Copper, of Manganese, and of Magnesium.			
5	Blood equivalent to 4 cwts. Sulphate of Ammonia	12	2
6	Blood equivalent to 2 cwts. Sulphate of Ammonia + 2 cwts. Sulphate Ammonia.	12	2

The plan adopted was a 6 by 6 Latin square the individual plots being 16 yards long by 4 rows wide, the two centre rows being weighed at the time of digging for the purpose of comparison, the outside rows being treated as buffers.

Every farmer is familiar with the great degree of crop variation which obtains in a potato field even when the soil is apparently unform. Some years ago in consequence of such differences, the system of replication was adopted. This consisted of repeating the same plots several times in the same paddock and the 6 by 6 Latin square adopted in the experiments allowed of the 6 treatments 1, 2, 3, 4, 5 and 6 being repeated at random 6 times. This permits a mathematical analysis of the results by means of which it can be determined if such differences are likely to be brought about by the position of the plots in the field or may be due to experimental error.

The land chosen for the experimental work was a heavy clay loam and it is typical of much of the potato growing land in the Brunswick, Burekup and Waterloo areas.

The land in question had been planted in the previous season with potatoes and was chosen because in this particular type of country, a trouble known to many growers as rust or bronzing of the foliage of potato plants was prevalent and has shown in this area, to my knowledge, for the past 20 years.

It was first thought that wet conditions were responsible for the trouble but subsequent observations and collaboration with Mr. H. A. Pittman, Plant Pathologist, has suggested that some soil deficiency may be responsible.

As such apparent disease is worse in any paddock after its having been planted with potatoes in successive years, it was considered that trials embodying minor elements would prove interesting and informative on such land. The site of the trials was ploughed at the period of the early autumn rains, in April, and was well harrowed prior to planting which took place on the 9th, 10th and 11th of June. The area was planted with large certified seed grown at Denmark and

was cut into sets of from 1½ to 2 ozs., the land being ploughed to a depth of about 4½ inches, the sets being planted at a depth of about 3 inches. To facilitate drainage and allow of equal conditions throughout, 4 rows were planted at about 30 inches apart in each "land," which was fairly well "crowned up." All the fertiliser was applied along the furrow at the time of planting, the minor elements being incorporated in the manurial mixtures.

The usual cultivations and hand hoeing for the control of weeds were carried out and "moulding up" of the crop completed the cultivation. The harvesting of the crop took place during the third week in October.

The weather at the time of planting was ideal, but cold and rather wet conditions were experienced during July and August. During September and early October the conditions were good and ample rain fell prior to harvesting.

The results of the trials are attached below:—

Set.	Fertiliser Treatment. Per acre.	Average Yield of 6 Plots. lbs.	Computed Yields (tons per acre). tons cwts.	Percentage of average yield of the experiment. %
1	4 cwts. Sulphate of Ammonia ... 4 „ Superphosphate ... ... 2 „ Sulphate of Potash ...	489	7 5	89.3
2	4 cwts. Sulphate of Ammonia ... 4 „ Superphosphate ... 2 „ Sulphate of Potash ... 20 lbs. Sulphate of Zinc ... ... 20 „ „ „ Copper ... 20 „ „ „ Manganese ... 20 „ „ „ Magnesium ...	499	7 8	91.1
3	4 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 2 „ Sulphate of Potash (Control)	560	8 6	102.2
4	4 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 2 „ Sulphate of Potash ... 20 lbs. Sulphate of Zinc ... ... 20 „ „ „ Copper ... 20 „ „ „ Manganese ... 20 „ „ „ Magnesium ...	549	8 3	100.2
5	Blood equivalent to 4 cwts.... Sulphate of Ammonia ... 12 cwts. Superphosphate ... 2 „ Sulphate of Potash ...	591	8 15	107.8
6	Blood equivalent to 2 cwts. Sulphate of Ammonia ... ... 2 cwts. Sulphate of Ammonia 12 „ Superphosphate ... 2 „ Sulphate of Potash ...	597	8 17	108.9

Standard error per treatment yield is 5.2 cwts. per acre.

These results show that no benefit was derived by the use of minor elements included in the fertiliser mixtures. The analysis of the table indicates that the only significant increase in crop was obtained by the application of 12 cwt. superphosphate per acre in the mixtures as against 4 cwt. per acre.

A second series of experiments was carried out, the layout being identical with the previous trials. This series was devised to ascertain the effects in fertiliser mixtures of:—

A. (1) Sulphate of potash applied to the land one month prior to planting.

(2) Potash applied in the furrow at planting time.

(3) Potash applied as a top dressing at the period of the emergence of the plants.

B. (1) Sulphate of ammonia applied in the furrow at the time of planting.

(2) Half the ammonia being applied at planting time and half as a top dressing at the period of emergence.

(3) The application of a further 2 cwt. per acre as a top dressing.

There has been a tendency in the last few years in the South-West, for growers to heavily top dress the spring crop with sulphate of ammonia, some growers using 3 bags per acre. The Potato Branch has recommended sulphate of ammonia as a top dressing at the rate of 1½ to 2 cwts. per acre.

It is desired to ascertain if such a heavy dressing is correspondingly beneficial, therefore these trials will be repeated in the future.

The site of the trials was marked out one month prior to planting, which took place at the same period as the foregoing experiment, and the plots, which were to be predressed with sulphate of potash, had this material applied and harrowed in.

The other fertiliser mixtures were applied in the furrow with the potato sets as planting proceeded. In the case of the sulphate of ammonia this constituent was halved in two cases and the desired quantities used as a top dressing soon after the time of the emergence of the plants on August 1st, heavy rain following its application.

The results are tabulated below:—

Set.	Fertiliser Treatment.	Average Yield of 6 Plots.	Computed Yields (tons per acre).	Percentage of average yield of the experiment.
	Per acre.	lbs.	tons cwt.	%
1	4 cwts. Sulphate of Ammonia ... 12 „ Superphosphate (Control) ... ... 2 „ Sulphate of Potash .. All fertiliser applied in furrow ...	493	7 6	94.3
2	4 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 2 „ Sulphate of Potash ... Potash pre-dressed 1 month before planting	486	7 4	92.9
3	4 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 2 „ Sulphate of Potash ... Potash top-dressed at emergence of plants	494	7 7	94.5
4	4 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 0 „ Sulphate of Potash ...	440	6 10	84.1
5	2 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 2 „ Sulphate of Potash ... 2 „ Sulphate of Ammonia ... Top-dressed on emergence	618	9 3	118
6	2 cwts. Sulphate of Ammonia ... 12 „ Superphosphate ... 2 „ Sulphate of Potash ... 4 „ Sulphate of Ammonia ... Top-dressed on emergence	608	9 0	116

Standard error per treatment yield is 4.9 cwts. per acre.

In the case of the nitrogen trials there is a most significant increase where the sulphate of ammonia was divided, 2 cwts. per acre at planting time with 2 cwts. applied as a topdressing against the 4 cwts. all applied at planting time.

It is interesting to note that no increase was obtained by the addition of extra ammonia as a topdressing. During the growing period no difference in the top-dressed plots was noted. If anything, growth seemed to favour the plots which had received the 2 cwts. per acre. The actual figures indeed show slightly in favour of these plots, but the increase is not significant.

It would appear from these trials that the extra quantity of sulphate of ammonia is not economically sound but one swallow does not make a summer and these trials will be repeated.

Response to Potash. Control of Rust or Bronzing of potato foliage.

In the case of the potash series an interesting development occurred. There was an almost total absence of the so-called rust or bronzing in those plots that had received potash, whilst the no-potash plots were badly affected.

The presence of this trouble always has the effect of seriously affecting the yield and indeed the results from the "no potash" plots were worse than the actual figures reveal. In the two furrow rows in each plot, being treated as buffers, the tubers were not weighed and in some instances hardly any ware potatoes were dug, whereas in all the plots which had received a complete manure there was apparently little difference in the yields of the "furrow" and "crown" rows.

At this stage of the trials, I do not intend to convey the idea that this trouble is caused solely by a potash deficiency, but two years ago I had an indication that this constituent materially assisted in checking the apparent disease, and this year's results show a similar effect.

That a wet soil condition aggravates the trouble is well known to me, as I have never observed this phenomenon on the higher hill soils, and it seems to be prevalent only on the "plain" country. The trouble has been definitely on the increase during the past few years, and this may be due in some measure to the heavy nitrogen manuring with little or no potash in the fertiliser mixtures.

For many years in the South-West from Harvey to Dardanup, potatoes have been planted with a fertiliser containing no potash. The potato is noted for its necessity for a well-balanced fertiliser, and these trials would suggest that about 2 cwts. of sulphate of potash per acre should be applied in the fertiliser mixture used. Thus, if we take a "potato manure" containing, say, 8 per cent. of potash (sulphate of potash is 48 per cent. potash), about 12 cwt. per acre would give an equivalent amount to that used in the trials.

For the benefit of those growers who are not familiar with this "rust" or bronzing of potatoes, the symptoms are here outlined. As the potato plants approach the flowering period, the foliage turns very dark, almost a bluey-green, glossy, with a ridging of the leaf between the veins; later a colour change takes place, the leaf between the veins showing firstly as a yellow tinge, later turning to a rusty or bronze colour; the leaves become brittle and roll upwards.

Numerous dark spots are observed on the leaves and in the last stages the leaves blacken, the tops of the plants often show aerial tubers (as in the case of plants affected with Rhizoctonia), and in many instances the tubers are affected, showing a purpley-black stain on the stem ends of the potatoes. If such tubers are bagged immediately after digging, sweating seems to take place and much rot is occasioned. If such potatoes, however, are allowed to remain in the sun,

without, of course, being allowed to be sunburned, the affected portion dries up and further decay is apparently arrested.

I wish to stress the fact that, while it is not suggested that potash deficiency is responsible, the fertiliser trials have given an indication that well-balanced fertilisers will alleviate to a great extent the effects of the trouble, and it is hoped that growers will benefit by the early publication of the first of a series of such experiments.

Summary.

(1) The inclusion of certain minor elements in fertiliser mixtures in heavy soil at Burekup did not appear to have any beneficial result on the potato crop.

(2) Twelve hundredweight of superphosphate per acre in the fertiliser mixture gave an increased yield over 4 cwt. per acre so applied.

(3) No difference was apparent in the various methods of the application of potash whether predressed one month prior to planting, sown at planting time, or applied as a top-dressing at the time of the emergence of the plants.

(4) The plots which had received no potash showed a decreased yield which was occasioned by the presence of so-called "rust" or "bronzing" of the potato foliage.

(5) There was a significant increase in yield where half the sulphate of ammonia was applied in the furrow at planting time and half used as a top-dressing when the plants emerged.

(6) There was no beneficial effect by using an extra 2 cwt. of sulphate of ammonia per acre as a top-dressing.

(7) The heaviest yield was obtained with a mixture of 4 cwt. of sulphate of ammonia, 12 cwt. of superphosphate and 2 cwt. of sulphate of potash per acre, 2 cwt. of sulphate of ammonia being applied at planting time and 2 cwt. as a top-dressing when the plants were just through the ground. The analysis of the above mixture approximates 2.57 per cent. nitrogen, 16.5 per cent. phosphoric acid, and 6 per cent. potash, plus 2 cwt. of sulphate of ammonia as a top-dressing.

(8) The use of blood to replace sulphate of ammonia in the fertiliser mixture has not shown any significant effect on the yield.

THE OCCURRENCE OF SOLONETZ (STRUCTURAL ALKALI) SOILS IN WESTERN AUSTRALIA.

G. H. Burvill[1] and L. J. H. Teakle[2].

SUMMARY.

The occurrence of soils belonging to the group of solonetz, or structural alkali soils, first recognised in Russia, is recorded for Western Australia.

Identified with this group are the soils of the Scaddan series, occurring in the southern portion of the Salmon Gums district. They have a sandy surface and a sandy clay subsoil, the upper part of which is divided into rounded topped columns up to one foot across.

Other soil series, viz., Circle Valley, Wallambim and Pallarup, having sandy surfaces and sandy clay subsoils, and showing several features of the solonetz profile, have also been mapped in extensive soil surveys in the mallee soil zone of Western Australia.

---

[1]Agricultural Adviser, Department of Agriculture, W.A.
[2]Plant Nutrition Officer, Department of Agriculture, W.A.

Some at least of these soils have formed on Tertiary marine sediments, but other soils of the group are probably forming on other geological structures. They are low in nitrogen and exceptionally low in phosphoric acid, but well supplied with potash. The subsoil clays usually show a preponderance of replaceable magnesium but sodium may predominate and is always present in large proportions.

In all cases the development of the solonetz structure is related to conditions favouring natural leaching of the soil.

The agricultural value of solonetz soils is discussed. In the Salmon Gums district the less columnar types, for example the Circle Valley series, have proved the most satisfactory soils for cereal cultivation, but the best examples of the solonetz around Scaddan (the Scaddan series) will probably prove more valuable for pasture development than for cereals.

INTRODUCTION.

Throughout the drier regions of all the great land masses of the world occur soils which are grouped as saline and alkali soils. The saline soils contain unusually large amounts of water soluble salts when compared with the normal soils of the same or other regions, while the alkali soils, though now only low or medium with respect to salts, frequently owe some of their characteristics to the presence of excess soluble salts at an earlier stage in their development. Both types occur extensively in eastern Europe and Asia, and according to Zakharov (1927) they comprise 24 per cent. of the area of the U.S.S.R. It is not surprising, therefore, that Russian soil scientists have for a long time made intensive studies of these soils, or that the names *solonschak* and *solonetz*, used in Russia for these soils, should have been adopted by soil workers throughout the world.

WHAT IS A SOLONETZ SOIL?

Confusion over the characteristics of solonetz soils has been discussed by Kelley (1934, (b)) and Shaw and Kelley (1935). In the earlier paper Kelley put forward the view that the terms *solonschak* and *solonetz* probably originated centuries ago among the peasants of south-eastern Russia, where the term *solonetz* is used to describe the soil which contains little salt in contrast with the highly saline *solonschak*.

Field and laboratory studies were commenced by the Russians towards the end of last century, and it was first pointed out by Zemiatchensky in 1894 that the solonetz profile has a well developed columnar subsoil. The work of Gedroiz from 1912 onwards, dealing with the chemical properties of solonetz soils, emphasised the importance of exchange reactions, and particularly exchangeable sodium, in the origin and development of these soils. But while Gedroiz and his followers defined the solonetz as an alkali soil with small amounts of soluble salts and a significant proportion of sodium in the exchangeable bases, soil morphologists have tended to regard as solonetz soils all profiles exhibiting the characteristic structural features of the solonetz profile. In a review of a large volume of Russian soil literature Joffe (1931) gives the field characteristics of the solonetz profile as described by Zakharov as follows—

"0-5 cms. *A_1 horizon—light colour, no structure, loose, fine porosity.

5-10 cms. $A2_2$ horizon—lighter than A_1, foliated structure, slightly more compact.

* 1 inch equals approximately 2½ cms.

10-18 cms. B_1 horizon—dark, brown-chestnut, very compact, with cracks, columnar, the mass of which falls apart into many angular units; the columns are rounded at the top.

18-30-35 cms. B_2 horizon—slightly lighter in colour than B_1, nutty granular structure, fairly well stratified.

35 cms. + : C horizon—loess-like material with veins of soluble salts and carbonates.

The soluble salt content in the upper horizons of a solonetz is not great, at any rate, not much more than in any neighbouring normal soil."

In a more recent paper Nikiforoff (1937) discusses the morphological and chemical characteristics of the solonetz. He establishes that it is essentially an intrazonal type in the Chernosem, Chestnut and Brown soil zones, and characteristically occurs in small spots scattered through the areas occupied by the other soils.

The principal characteristics of the solonetz is the B. horizon or subsoil. This is an extremely dense and compact clay, which is very sticky and watertight when wet and which, as a result of repeated wetting and drying, has broken into angular prisms. These prisms are usually 1-3 inches across and 2-4 times as long, and frequently show rounded tops. The surface soil or A. horizon is unsaturated and typically shows a bleached (often whitish) subsurface layer. It is generally up to one foot thick and is characteristically friable. In the subsurface the structure is often finely laminated and the boundary between this layer and the subsoil is typically sharp.

Chemically, sodium and/or magnesium are dominant in the replaceable base fraction.

A number of papers from America* deal with occurrences and properties of soil showing the solonetz morphology but in several it is pointed out that only small proportions of sodium occur among the replaceable bases. In Australia, columnar clay subsoils underlying bleached subsurface horizons of light texture have been recorded from the western Wimmera of Victoria (Mullett and Rankin Scott, 1923) and in the south-east of South Australia (Taylor et al, 1933†). Prescott (1931, pp. 29 and 63) suggested that a soil type carrying redwood (*Eucalyptus oleosa* var. *transcontinentalis*) near Fitzgerald Peaks, Western Australia, had affinities with the solonetz, also soils at Swan Hill, Victoria. Recently Penman (1936) has related some of the soils of the Goulbourn Valley, Victoria, to the solonetz, and Teakle (1937 (b)) has suggested that a heavy textured soil of the Folly Flats, 20 miles south of Perth, W.A., may belong to this group.

SOLONETZ (STRUCTURAL ALKALI) SOILS IN WESTERN AUSTRALIA.

In the course of soil surveys covering over one million acres in the Lake King, Lake Brown and Salmon Gums districts of Western Australia (see map Fig. 1) several soil types have been identified which have profile characteristics similar to

* Nikiforoff (1930) (1937), Joel (1932), Storie (1933 (a) and (b)), Kelley (1934 (a) and (b)), Kellogg (1934), Isaak (1934), Nieschmidt (1934), Ellis and Caldwell (1935), Murphy and Daniel (1935), Rost (1936).

† Taylor has privately communicated the fact, not stated in C.S.I.R. Bull. 76, that the Willalooka sand and the Monkoora sand showed well-developed round-topped columns, up to 4 inches across, in their subsoils.

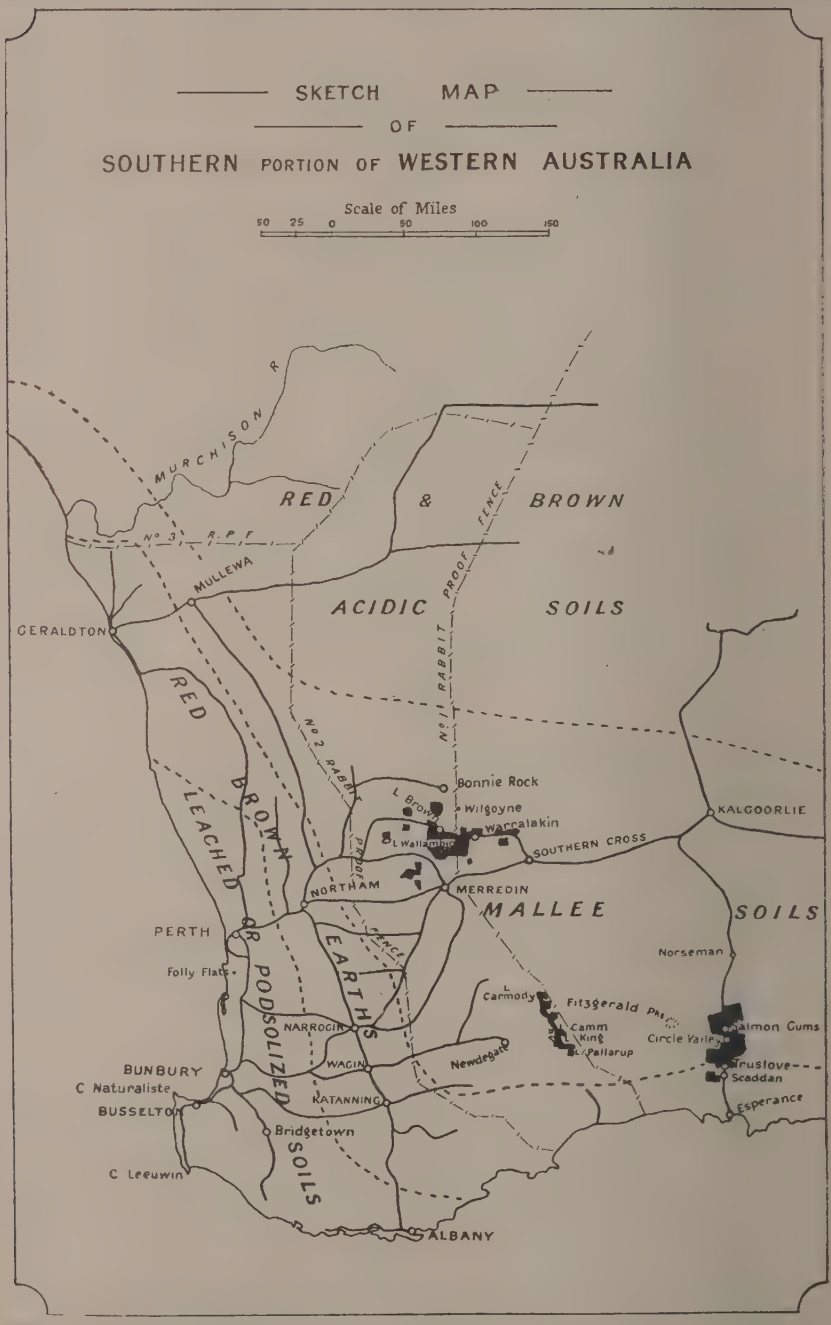


Fig. 1.—Map of the South-West portion of W.A., showing the mallee soil zone in relation to other soil zones, the location of soil surveys in which solonetz (structural alkali) soil have been recognised and mapped, and the places referred to in the text.

those of the solonetz. Their surface horizons are of sand, which is bleached in its lower portion and which passes abruptly to a tough sandy clay subsoil. Many farmers and others who have worked the greyish sandy surfaced soils of the mallee or salmon gum (*Euc. salmonophloia*) zone of the wheat belt will have noticed the irregularities of this underlying clay. Its surface is slightly irregular and lumpy in the drier areas, but under higher rainfalls (15 to 17 inches per annum) as around Truslove and Scaddan, well defined rounded topped columns 8 to 10 inches high and up to 12 inches across are to be found below the sandy surface.

The Scaddan series embraces such soils, and includes the best or most advanced examples of the columnar subsoil yet observed in Western Australia. Considering both its structure and chemical characteristics the Scaddan series is considered to be a good example of a solonetz. The nature of the columnar subsoil is illustrated by the photograph of Fig. 2 which shows the subsoil over an area of one square metre (approximately one square yard) exposed by scraping away the overlying

Fig. 2.—Photograph showing the tops of the soil columns after removal of the surface sand in the Scaddan series. (The measure is a yard stick.)

sand. It will be noted that individual columns are up to one foot across—a much larger size than the columns described for solonetz profiles in other parts of the world.

The Circle Valley series, whose soils have many points in common with those of the Scaddan series, also occurs extensively in the Salmon Gums district north of Truslove. In this case, the same well defined A_1, A_2 and B horizons occur as in the Scaddan series, but the sandy clay subsoil when exposed, shows only shallow grooves instead of deep, sand-filled clefts. The total area mapped of the Scaddan and Circle Valley series is 240,444 acres. A rather similar soil (Pallarup sand) has been mapped in surveys of the Lakes district, and it is known that large areas of

similar soils occur in the unsettled areas between Lake King and Salmon Gums. Another type related to the solonetz soils (Wallambin sand) occurs in the areas covered by the Lake Brown soil surveys. This soil, as well as other sandy surfaced areas between Lake King and Salmon Gums, has its vegetation association frequently dominated by redwood (*Euc. oleoso* var. *transcontinentalis*).

All the above soils occur within the zone of mallee soils (Prescott, 1931) a group which probably owes its special characteristics largely to accessions of cyclic salt, coupled with a rainfall whose leaching effect is small. The best developed solonetz profiles in Western Australia (and probably in South Australia) occur on the wetter margins of the mallee zone, where the leaching factor, especially on sandy surfaced areas, is sufficiently increased to cause the eluviation of clays containing a considerable proportion of replaceable sodium and magnesium; this process results in the development of rounded topped columns in the clay subsoil.

Rainfall data for Scaddan and Salmon Gums, Lake Brown and Lake King are given in Table 1.

THE SCADDAN SERIES.

A detailed description of a typical profile of this series is as follows:—

Horizon.	Depth. ins.	
A_1	0–1	Light grey brown sand, structureless, containing small roots.
A_2	1–2	Light grey to white sand which also fills the spaces between the rounded tops of the columns of the B_1 horizon and thus reaches to about 10 inches.
B_1	2–8	Dull yellowish and greenish-grey, hard sandy clay in irregular columns with well rounded tops (see Fig. 2). The columns are up to one foot across and have a coarse nut structure. In the upper part of each column there is some darkening due to organic matter.
B_2	8–27	Dull yellowish and greenish-grey compact sandy clay with more or less vertical pockets of whitish calcareous nodules and soft lime.
B_3	27–36	Dull yellowish and greenish-grey with faint light brown mottlings, compact sandy clay with scattered calcareous nodules. Small black specks appear in the sandy clay.
C	36–110+	Sandy clay, light brown and yellow-grey to grey and brown mottled in colour; texture becomes heavier with depth. (Similar clays under the related Circle Valley series have been found to rest on sandstone at depths of 15 to 20 feet.)

Mechanical analyses and chemical data for samples from this profile are given in Table 2, while Table 3 includes data on replaceable bases for these samples as well as for others from Western Australia profile showing characters of the solonetz. For comparison similar data for two Californian solonetzes are included (Kelley, 1934 (b)).

The natural vegetation on the Scaddan series consists of mallee and sapling Eucalypts 3 to 8 feet in height with an undergrowth of small teatrees (*Melaleuca spp.*). Common members of the vegetation are *Eucalyptus Forrestiana*, *E. Flocktoniae*, *E. dumosa*, *E. eremophila*, *Melaleuca uncinata*, *M. pentagona*, *M. cardiophylla*, and spp., *Grevillea plurijuga* and spp., *Daviesia aphylla*, *Exocarpus aphylla*, *Hakea laurina*, lamb poison (*Isotropis sp.*).

No more stunted vegetation is found on any of the soil types of the Salmon Gums district except that associated with ferruginous gravel, in which case heath may occur. Incidentally, it is noteworthy that, in this area, with increasing average annual rainfall (ranging from 11 to 16 inches) the average height of the eucalypts *decreases* from about 40 feet to 15 feet, suggesting that the increasing rainfall is insufficient compensation for changes in soil characteristics.

DISCUSSION.

The malle zone (Prescott, 1931) occupies roughly the 10 to 15 inch rainfall regions of southern Australia with mean annual temperatures mostly 60-65° F. There is a definite winter incidence of the rainfall, which is further characterised over a large part of the zone by a low average precipitation per wet day—less than 0.2 inches. Leaching and run-off under natural conditions are thus slight, and the accumulation of air-borne salts precipitated as dust and with rain is favoured. The salt (sodium chloride) content of rain water at Merredin and Salmon Gums has been determined over several years and has been discussed by one of us (Teakle, 1937). It has been shown that the accumulations of cyclic salt over a period of about 35,000 years would be sufficient to account for the salt found in the Lake Brown and Salmon Gums soils to depths of 50 feet.

Nevertheless there is geological evidence discussed by Jutson (1934) that part, if not all, the Southern portion of Western Australia was beneath the sea in Miocene times, and the soils of large areas of the mallee zone in W.A. may be developed on marine sediments of that period. In the Salmon Gums district marine sediments, of which a spicular sandstone is representative, certainly occur, and may be observed in exposures around numerous salt lakes. Borings to 15 to 20 feet in areas of the Circle Valley sand have encountered a similar sandstone and it is possible that the mottled sandy clay underlying for many feet most soil types of the Salmon Gums district is a stratum of marine origin.

On the other hand this strongly acid, mottled clay material occurs at relatively constant depths below the surface in practically all soil types and from some points of view appears to be a definite part of the soil profile. In 26 sites the average and modal depth at which this horizon was encountered was eight feet and the range three feet to 12 feet. It seems unlikely that a marine deposit would follow so closely a surface obviously modified by wind action and erosion. The virgin soils are all high in salt to great depths. (In the deep subsoils total water soluble salts figures are usually 0.5-1.25 per cent. with chloride, expressed as sodium chloride 0.4-1.0 per cent). It may be that both cyclic salt and residual salt from the Tertiary submersion have contributed to the salt now present in these soils

In other parts of the world soils with solonetz morphology appear to develop very commonly on marine and lacustrine sediments. Vilensky (1930) found alkali soils, which include the solonetz, very common on the Aralo-Caspian lowland of south eastern Russia, which represents a sea bottom of post Tertiary times. The west Siberian plains were also occupied by the sea in Tertiary times and on the salt impregnated sediments, saline and alkali soils are now found. Many of the solonetz-like areas in California are developed on marine terraces which still show stratification. They are discussed by Storie (1933 (a) and (b)), and Kelley (1934 (b)) and Nikiforoff (1937) and seem to occur under climatic conditions generally similar to those in the mallee zone of Australia, viz., 8-20 inches annual rainfall with winter incidence, 60-62° F. mean annual temperature. Nikiforoff (1930), Joel (1932), Ellis and Caldwell (1935) and Rost (1936)

describe solonetz soils developed on the lacustrine clays of the glacial Lake Agassiz which formerly covered parts of Minnesota, Saskatchewan and Manitoba. Murphy and Daniel (1935) consider the solonetz soils of Oklahama to be derived from saline marine sediments, while in Western North Dakota marine deposits are included by Kellogg (1934) among the parent materials of solonetz complexes.

From the papers of Storie and Kelley it appears that the Huerhuero fine sandy loam of southern California resembles the Scaddan sand both in general profile features and in the composition of its replaceable bases. The similarity both in amount and composition of the bases is apparent from Table 3. Leaching soil with fresh sea water has been shown by Kelley to give replaceable bases in proportions very similar to those in the subsoils of these types and he considers that such magnesium-sodium clays point to a probable marine origin.

In Australia, and, indeed in Western Australia, certain soil types with magnesium-sodium clays are undoubtedly formed on marine or lacustrine sediments of Tertiary age, but the position is by no means certain for many other such types. In many cases in Western Australia, physiographic evidence would indicate a parent material formed in situ from rocks of Precambrian age.

Columnar structure in Western Australia tends to form where the surface is a sand, which promotes absorption, downward penetration and retention of water. Adjacent types, no more than a few feet distant and at substantially the same level, but without the sandy surface are similarly saline and solonised but do not exhibit the solonetz structure. This would indicate that the development of the structure is a function of the liability of a soil type to a certain amount of leaching. Sodium salts, whether of marine or cyclic origin, are the raw materials for producing solonisation and it is difficult to believe that recent marine or lacustrine sediments are essential for the formation of solonetz or even solonised soils.

The possibility that the surface sand is a transported stratum deposited on the surface of the clay must not be overlooked. However, the subangular and rounded sand grains of the subsoil clay resemble those of the surface horizon (see next paragraph) and the ratio of fine sand to coarse sand (Table 2) is reasonably constant throughout the profile. If the surface sand were a transported stratum a different fine sand: coarse sand ratio might have been expected. Hence it is concluded that the layering of sand over sandy clay in this case probably represents a true soil profile formation and not a geological stratification.

Through the courtesy of Dr. Dorothy Carroll, of the University of W.A., a mineralogical examination has been made of the samples from the Scaddan profile discussed above. The materials finer than the coarse sand fraction were examined from samples A1743-1746 and A1750. The quartz grains were found to be subangular to rounded, while the clay material was "felty" and semi-opaque and yellowish brown and pale brown in colour. The optical properties (refractive index 1.53) indicated that the clay belongs to the beidellite group of clay minerals. In the deep sample A1750 were observed a proportion of some clear brighter brown particles with refractive index just over 1.56 indicating a trend towards the nontronites in the deeper horizons.

The chemical analyses (Table 2) of the Scaddan soil show several interesting features. Total nitrogen is low throughout the profile and an extremely low phosphorus level is indicated. On the contrary, potash is very high in all the subsoil samples and reaches 0.908 per cent. (K_2O) in the B_2 horizon. The organic carbon figures indicate an accumulation of organic matter in the column tops, which,

as a result, show the darkening mentioned in the profile description. The surface sand is neutral in reaction (pH 6.92) and the column tops (pH 7.40) are less alkaline than the B_2 horizon clays containing calcium carbonate. The pH of 4.45 at 96-112 inches is similar to that at similar depths in most mallee zone profiles in W.A.

SOLONETZ SOILS IN AGRICULTURE.

Solonetz soils, generally, have features which are undesirable in good agricultural soils. Where, as in California, they are utilised under irrigation the dense clay subsoil does not allow ready penetration of water; Storie (1933 (a)) records that losses have been large in southern California where such soils have been planted with citrus and avocado. In evaluating the soils of those regions he (1933 (b)) gives the solonetz soils ratings of only 20 to 50 compared with a maximum possible rating of 100 for the best agricultural soils. In the prairie regions of U.S.A. small areas of solonetz soil occur spotted throughout the normal soils. They are particularly subject to erosion and produce the bare so-called "slick" spots when the tough intractable subsoil is exposed. Isaak (1934), Kellogg (1934) and Murphy and Daniel (1935) have studied the "slick" spots in Idaho, North Dakota and Oklahoma respectively. At Goroke, in Victoria, Mullett and Rankin Scott (1923) found that the application of 1½ tons per acre of gypsum, in addition to the usual dressing of 1 cwt. per acre of superphosphate increased the yield of wheat on a solonetz soil from 15.7 to 26.5 bushels.

In Western Australia most evidence on the agricultural value of these soils is available from the Salmon Gums district, and here owing to the peculiar soil problems of the area they have proved by comparison the most satisfactory soils for cereal cultivation. Nevertheless returns have been generally better in the lower rainfall portions of the district on the Circle Valley sand than at the wetter southern extremity round Scaddan, where the well developed solonetz soils of the Scaddan series occur. With a rainfall of 16-17 inches at Scaddan it should, however, be possible to develop useful pasture grasses and even the Dwalganup strain of subterranean clover, and make cereal cropping secondary to grazing.

After clearing, sandy surfaced soils of the Circle Valley and Scaddan series are found to undergo a marked leaching of soluble salts from the upper portions of their subsoils. This has been one reason for their superiority over the heavy textured and powdery calcareous ("kopi") soils in the Salmon Gums district. The sandy surfaces also aid in moisture conservation but are subject to some wind erosion, and, if originally less than a few inches deep, the tough sandy clay subsoil may be exposed by wind action or by ploughing. If broken up by the plough the subsoil does not form a good tilth but runs together on wetting, and sets very hard on drying. Bare spots in crop or pasture usually result, and surface accumulation of salt frequently occurs at such spots.

It is significant that, on the basis of the composition of the replaceable base fraction, the soils of the "mallee" zone generally are solonised, sodium and magnesium being the most abundant bases, but the structural characters of the solonetz have not generally been developed except in certain soil series resembling those described. The non-structural soils are usually highly productive for cereals when the rainfall is adequate. Where the solonetz structure is evident, however, as in the Scaddan and related series, cultural difficulties arise but the use of soil ameliorants, such as gypsum, gives promise of alleviating the condition and raising the productivity level to that of the more favoured non-structural types.

ACKNOWLEDGMENT.

Acknowledgment is here made of the valuable assistance rendered by Professor J. A. Prescott of the Waite Institute to one of us (G.H.B.) in locating several interesting papers on solonetz occurrences. All of the literature cited was examined in the library of the Waite Agricultural Research Institute, Adelaide.

TABLE 1.

Rainfall Data for Areas in W.A. where Soils with Solonetz features occur.

Centre.	Rainfall Points.												Rain per rain day.	Records (years).
	Jan.	Feb.	Mar.	Apl.	May.	June	July.	Aug.	Sep.	Oct.	Nov.	Dec.	Year.	
Scaddan	48	50	118	157	225	222	168	193	145	138	95	86	1,645	21·5	19
Salmon Gums	52	55	121	113	138	149	138	146	99	117	81	73	1,282	16·9	15
Lake King	55	16	136	74	159	151	192	175	101	141	36	56	1,292	16·0	7
Lake Brown	49	36	97	93	107	145	148	127	71	54	37	59	1,023	15·8	18

100 points = 1 inch.

TABLE 2.

Mechanical Analyses and Chemical Data for a Profile showing Well-developed Solonetz Structure (Scaddan Series, Truslove, W.A.).

Sample No.	1743	1744	1745	1746	1747	1748	1749	1750
Horizon	A_1–A_2	B_1	B_2	B_3	....	C	...	...
Depth (inches)	0–2	2–8	8–27	27–36	36–50	50–72	72–96	96–100
	%	%	%	%	%	%	%	%
Coarse sand	27·8	20·8	16·6	17·3	....	....	....	12·7
Fine sand	65·5	41·7	38·7	41·6	....	....	....	25·7
Silt	1·7	1·2	0·2	0·3	....	....	....	1·1
Clay	4·6	32·3	35·5	36·6	....	....	....	56·3
Loss on acid treatment	0·2	1·6	6·2	1·9	....	....	....	1·3
Moisture	0·4	3·4	4·0	3·6	....	....	....	4·6
Loss on ignition	1·6	4·6	5·7	4·0	....	....	....	7·1
Calcium carbonate	....	0·1	4·3	1·0	....	....	....	..
Total water soluble salts	0·034	0·25	0·47	0·51	0·52	0·53	0·58	0·64
Chloride (as NaCl)	0·008	0·11	0·28	0·37	0·41	0·42	0·41	0·48
Organic carbon	0·595	0·665	0·153	0·085	....	....	....	0·169
Total nitrogen (N)	0·027	0·028	0·013	0·011	....	....	....	0·011
Potash (K_2O)	0·064	0·598	0·908	0·750	....	....	....	0·787
Phosphoric acid (P_2O_5)	0·003	0·005	0·003	0·003	....	....	....	0·004
Reaction (pH) (1 : 2·5 quinhydrone)	6·92	7·40	8·55	8·35	8·04	7·60	5·47	4·45
C : N ratio	22·0	23·8	11·8	7·7	....	....	....	15·4
Fine sand : coarse sand ratio	2·36	2·00	2·34	2·41	....	....	....	2·02

Analyses by Government Chemical Laboratory, Perth.

TABLE 3.

Replaceable Bases of W.A. Soils, showing Solonetz features.

Soil Type.	Serial No.	Horizon.	Depths.	Clay, less than ·002 mm.	Replaceable Bases.	Percentage of Total Bases.				pH.
						Ca.	Mg.	K.	Na.	
			ins.	%	m.e. %.*					
Scaddan sand (Truslove, W.A.)	1743	A_1A_2	0–2	4·6	2·39	61	23	11	5	6·92
	1744	B_1	2–8	32·3	18·40	21	49	6	24	7·40
	1745	B_2	8–27	35·5	19·34	18	41	8	33	8·55
	1746	B_3	27–36	36·6	18·87	13	45	9	33	8·35
	1750	C	96–110	56·3	15·01	1	52	9	38	4·45
Circle Valley sand (Salmon Gums Research Station)	....	A	0–7	....	6·45	61	24	6	9	7·81
	....	B_1	7–15	....	15·17	21	42	11	26	8·34
	....	B_2	15–30	....	19·97	10	40	15	35	8·43
Pallarup sand (Lake Camm, W.A.)	466	A_1A_2	0–6	5·0	7·21	42	41	6	11	7·55
	467	B_1	6–14	43·2	21·69	18	35	15	32	8·39
	468	B_2	14–27	39·3	22·25	15	34	17	34	8·25
	469	....	27–43	47·2	23·83	12	33	19	36	8·09
Wallambins and Wilgoyne, W.A.)	598	B_2	17–31	....	19·78	30	36	7	27	8·31
	600	B_3	38–48	....	15·09	26	38	9	27	8·39
Huerhuero series (Oceanside, California) (Kelley, 1934 (b))	....	A	½–10	....	10·8	59	35	3	3	7·31
	....	B_1	10–20	....	23·6	28	53	2	17	7·56
	....	B_2	20–35	....	19·6	26	51	2	21	8·96
Antioch series (Salinas, California) (Kelley, 1934 (b))	....	A	0–18	....	7·6	64	28	1	7	6·36
	....	B_1	18–24	....	20·5	41	43	0	16	7·64
	....	B_2	30–37	....	27·6	28	42	1	29	8·40

* Milli-equivalents per 100 grams of soil.

LITERATURE CITED.

Ellis, J. H., and Caldwell, O. G.:
1935: Magnesium clay "solonetz" Trans. 3rd Int. Con. Soil Sci. Oxford. Vol. I.: 348-350.

Isaac, P.:
1934: The nature of slick soils in Southern Idaho. Soil Sci. 37: 157-166.

Joel, A. H.:
1932: Genesis and morphology of cool, semi-arid soils in Saskatchewan, Canada. Amer. Soil Surv. Assn. Bull. 13: 53-58.

Joffe, J. S.:
1931: Russian studies on soil profiles. Amer. Soil Surv. Assn. Bull. 12: 12-39.

Jutson, J. T.:
1934: The Physiography of Western Australia. Geol. Survey, W.A. Bull. 95, p. 199.

Kelley, W. P.:
1934: (a) The formation, evolution, reclamation and absorbed bases of alkali soils. Jour. Agri. Sci. 24: 72-92.
(b) The so-called solonetz soils of California and their relation to alkali soils. Amer. Soil Surv. Assn. Bull. 15: 45-52.

Kellogg, C. E.:
1934: Morphology and genesis of the solonetz soils of Western North Dakota. Soil. Sci. 38: 483-503.

Mullett, H. A., and Rankin Scott, P.:
1923: Improvement of mechanical condition of soils and subsoils. Jour. Agr. Victoria 21: 583-597.

Murphy, H. F., and Daniel, H. A.:
1935: Some chemical and physical properties of normal and solonetz soils and their relation to erosion. Soil. Sci. 39: 453-462.

Nieschmidt, E. A.:
1934: Observations on the morphology of solonetz soils in north central Nebraska. Amer. Soil Surv. Assn. Bull. 15: 70.

Nikiforoff, C. C.:
1930: Solonetz and Solonchak soils of the Red River (Minnesota). Amer. Soil. Surv. Assn. Bull. 11: 141.
1937: The solonetz-like soils in Southern California. Jour. Amer. Soc. Agron. 29: 781-796.

Penman, F. E.:
1936: Claypan and buckshot soils of a Goulbourn Valley area. Jour. Agr. Victoria, 34: 364-376.

Prescott, J. A.:
1931: The soils of Australia in relation to vegetation and climate, C.S.I.R., Australia, Bull. 52: 29 and 63.

Rost, Clayton O.:
1936: Characteristics of some morphological solonetz soils of Minnesota. Jour. Amer. Soc. Agron. 28: 92-105.

Shaw, C. F., and Kelley, W. P.:
1935: The meaning of the term "solonetz." Trans. 3rd Int. Con. Soil. Sci. Oxford. Vol. I.: 330-334.

Storie, R. Earl:
1933: (a) Profile studies of the solonetz soils of California. Amer. Soil. Surv. Assn. Bull. 14: 43-46.
(b) The classification and evaluation of the soils of Western San Diego country. Univ. of Calif. Coll. of Agr. Bull.: 552.

Taylor, J. K., *et al.*:
1933: A soil survey of the hundreds of Laffer and Willalooka. C.S.I.R. Australia Bull.: 76.

Teakle, L. J. H.:
1937: (a) Salt (sodium chloride) content of rain water. Jour. Agric. W.A., 2nd series, 14: 115-123.
(b) The peat and related soils of Western Australia. *Ibid* 14: 332-358.

Vilensky, D. G.:
1930: Brief history and principal summary of investigations of saline and alkali soils in U.S.S.R. Trans. Comm. V. Second Int. Con. Soil Sci. Moscow: 309-326.

Zakharov, S. A.:
1927: Kurs Pochvovedeniya. A text book on soil science Moscow Leningrad. pp. 440. Quoted by Joffe, J.S., 1931: Amer. Soil. Surv. Assn. Bull. 12: 12-39.

PASTURE DEVELOPMENT.

H. G. Elliott,
Agricultural Adviser. (Dairy Branch.)

The Third Year's Report on the Irrigated Rotational Grazing Demonstration being conducted by the Department of Agriculture in conjunction with the Australian Dairy Council on the property of Mr. A. E. Jackson, Roelands.

A resumé of the First and Second Years' operations was published in the March, 1936 and 1937 issues of this Journal.

The total area of the demonstration is 12.895 acres.

During the early part of 1936, the area of irrigated pasture was increased from the original 10 acres, and the full grazing was obtained over the whole area from 1st May, 1936.

The objects of the demonstration included—

1. The collection of information as to whether it would be more profitable to establish permanent pasture with a cover crop than to sow the permanent perennial pasture alone.
2. The collection of data regarding the carrying capacity of small irrigated areas.
3. The collection of data to show the change in composition due to rotational grazing under irrigated conditions.
4. To obtain the monthly yield of green material per acre.
5. To test the effect of varying the time between waterings during the irrigation season.

All the particulars regarding soil types, seed mixtures, fertilisers, cultivation, irrigation, cover crops for each plot were given in detail in the previous reports and are briefly as follow:—

1. Seed mixtures were sown during the 8th to 12th November, 1934.
2. The following Standard Seed Mixture was applied to all plots—

   New South Wales Paspalum dilatatum 10 lbs. per acre + New Zealand Certified White Clover, Mother Strain, 2 lbs. per acre.

The additions being as follow:—

Field 1. Standard Mixture + Sudan Grass 7 lbs. per acre.
Field 2. Standard Mixture + Italian Rye Grass 7 lbs. per acre.
Field 3. Standard Mixture + Japanese Millet 5 lbs. per acre.
Field 4. Standard Mixture + Perennial Rye Grass 7 lbs. per acre.
Field 5. Standard Mixture.

The following details give further results of the experiment for the year ending 31st December, 1937:—

Fertiliser:

The rate of application of fertiliser for the third year, 1937, was higher than that of the second year but still well below that applied during the first year. The quantity applied was 600 lbs. superphosphate in three applications. The *first application* of 150 lbs. per acre was applied on 25th January just prior to watering. The *second application* of 280 lbs. per acre was applied early in May; and the *third application* was made in August at the rate of 170 lbs. per acre.

The quantity of fertiliser applied during 1935 consisted of 904 lbs. superphosphate and 218 lbs. sulphate of ammonia per acre, whereas in 1936 374 lbs. superphosphate plus 28 lbs. sulphate of ammonia were applied.

It will be noticed from the above that no sulphate of ammonia was applied during the past season 1937.

Early in 1936, half of each field was limed at the rate of 4 cwts. of agricultural lime per acre; to date no effect from this application has been noticed.

Cultivation:

The only cultivation carried out during the season was harrowing. The first harrowing was carried out on 11th April and the second one on 28th August. The whole area was mown on 28th February and all the surplus material raked off.

Irrigation:

Irrigation was carried out on 27th January, 28th February, and 27th March, but the irrigation was altered during the 1937-38 season to determine what effect fortnightly, three-weekly, and monthly waterings would have on the yield and composition of the pastures.

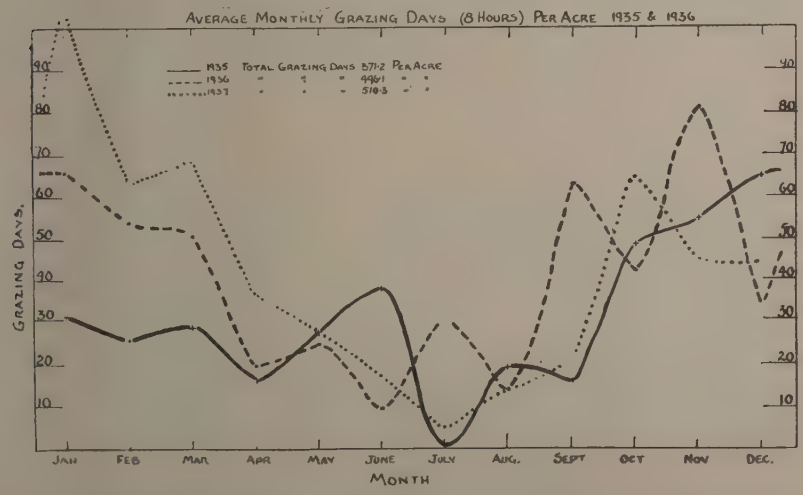
It will be seen from Table No. 1 that, at the end of 1937, with the exception of field No. 3, all the fields have given approximately the same amount of grazing for the twelve months. Consequently it was decided to apply water to two of the fields at monthly intervals, two at three-weekly intervals, and one at fortnightly intervals. The amount of water being applied per acre to each of the fields at each watering is being measured.

The following table shows the grazing days per acre which were obtained per month on each plot:—

	Field No. 1.	Field No. 2.	Field No. 3.	Field No. 4.	Field No. 5.	
January ...	133·3	98·9	104·6	118·3	82·2	107·5
February ...	56·6	80·0	60·4	58·8	56·7	62·5
March ...	32·3	70·9	59·4	62·7	113·7	67·7
April ...	21·8	17·7	29·6	36·7	67·0	34·5
May	64·6	16·8	22·2	14·2	10·6	25·4
June ...	2·0	8·7	17·5	43·1	12·5	16·8
July ...	...	...	6·8	7·1	7·3	4·2
August ...	11·8	13·7	9·6	15·5	17·2	13·6
September ...	35·0	20·7	14·6	23·2	14·6	21·6
October ...	45·2	41·3	80·0	87·3	67·5	64·3
November ...	74·3	59·2	21·8	22·6	44·9	44·6
December ...	53·0	69·4	36·6	35·5	25·3	43·9
Total ...	529·9	497·3	463·1	523·0	519·5	506·6
Average ...	44·2	41·4	38·6	43·6	43·3	42·2

From the above table it will be seen that the fields averaged approximately 42 grazing days per acre per month, and, with the exception of field No. 3 which gave 38.6 grazing days per acre per month, all the other plots averaged approximately the same amount of grazing.

The total amount of grazing obtained for all fields averaged 506.6 grazing days per acre per annum. This is slightly in excess of that obtained for the season 1936, which was 496.1, and, from the previous reports, it will be seen that 371.2 grazing days were obtained per acre for the year 1935.



The above graph shows the monthly productions for the three seasons.

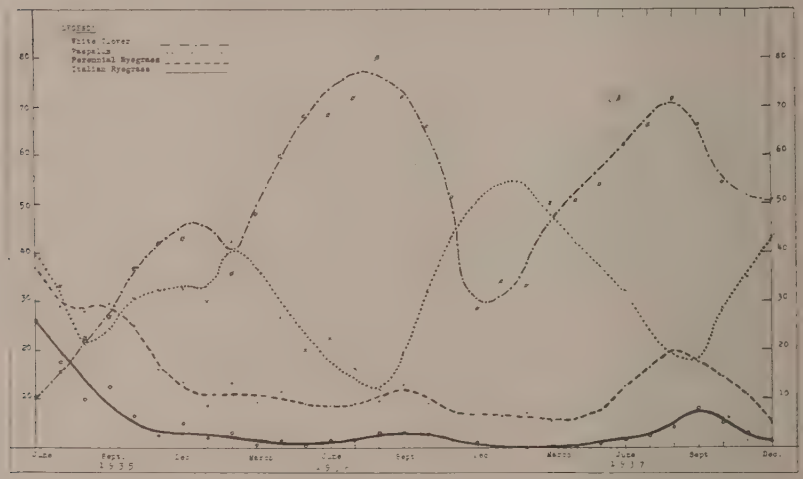
The full grazing production for the years 1935, 1936, and 1937 was as follows:—

Year.	Grazing Hours.	Total Grazing Days.	Grazing Days per Acre.	Acres per Cow.
1935	38,373	4,796·6	371·2	0·97
1936	47,019	5,877·4	496·1	0·73
1937	52,200	6,525·0	506·6	0·72

From the above it will be seen that the whole area has a high carrying capacity, and, in the season 1937, the carrying capacity was just under ¾ of an acre per cow.

Botanical Analyses.

Botanical analyses have been carried out at monthly intervals on each field from June, 1935, to December, 1937.



The above graph shows the percentage cover of perennial ryegrass for field No. 4. It will be seen from the graph that, in June, 1935, the percentage cover was 37 per cent., and, from then until December, 1935, there was a steady decline to 13 per cent; since that time it has remained fairly steady with the exception of the periods August to October of 1936 and 1937 when there was a decided increase in the percentage cover.

With the Italian ryegrass in field No. 2, the ground cover decreased from 26 per cent. in June to 5 per cent. in December, 1935. A similar increase to that of the perennial ryegrass in the months August to October, 1936-37, was noticeable, although the percentage cover for the months December to June was practically negligible.

The graph also shows that the percentage cover of Paspalum and white clover for all the fields varied considerably for the different seasons of the year. It will be noted that for the periods March to October each year the white clover is

predominant and that during the periods November to March the Paspalum is giving the bulk of the cover.

Yields per Acre.

On 10th July, 1936, three moveable quadrats which enclosed 50 sq. links were erected and set on each field, and the pasture enclosed has been cut at approximately monthly intervals from these.

The following yields were obtained per acre:—

Field No.	Period. 10th July, 1936, to 12th December, 1936.	17th July, 1937, to 15th December, 1937.
1	12·0 tons green	12·8 tons green
2	9·8 „ „	14·2 „ „
3	9·1 „ „	13·5 „ „
4	8·9 „ „	13·7 „ „
5	11·5 „ „	14·8 „ „

The production of green material per acre for the twelve months 12/12/36 to 15/12/37 was as follows:—

Field No. 1 = 29·1 tons per acre.
„ 2 = 28·7 „ „
„ 3 = 29·2 „ „
„ 4 = 24·9 „ „
„ 5 = 28·5 „ „

From the above it will be seen that, with the exception of field No. 4, the yield of each field was practically the same in weight of green material. It is interesting to note that no cuttings were carried out in July, as there was insufficiency of material to cut. It will be noted from the first table that there was very little grazing obtained for that month.

The following figures give the three-monthly yields for the different seasons of the year, taking spring as from September to November inclusive:—

Spring	...	6·9 tons green material per acre.
Summer	...	13·6 „ „ „
Autumn	...	5·7 „ „ „
Winter	...	1·9 „ „ „

From the above it will be seen that nearly half or 48.6 per cent. of the production was obtained in the summer months, December to February inclusive. Less than 7 per cent. of the total production was obtained during the winter months, showing that these three months are undoubtedly the ones where the least amount of grazing can be expected.

During the winter of 1937 further drainage was carried out to alleviate the excess moisture which ocurred on one corner of field No. 1. On this area there was a considerable growth of rushes. Control operations were carried out wherever rushes occurred on any of the fields.

Tentative Conclusions.

Results show that—

1. Rapid growing cover crops are detrimental to the initial establishment of white clover and, to a much lesser degree, Paspalum. If Couch

grass (*Cynodon dactylon*) is present prior to seeding, cover crops will definitely assist the spread of it to the detriment of the sown pastures.

2. Rapid growing cover crops cannot be recommended when establishing permanent pastures under irrigation.

3. Rates of superphosphate up to 6 cwts. per acre are profitable, and at least 4 cwts. per acre should be applied annually in two to four applications. Indications show that the heavier rates per acre should be applied in the autumn.

4. Super and ammonia mixtures are only recommended as an initial application at the time of planting; 2 cwts. per acre at least should be applied.

5. The following seed mixtures can be recommended for irrigated areas:—

(1)	*Paspalum dilatatum*	10lbs.	per acre.
	White Clover—Certified	2lbs.	„
(2)	Perennial Rye Grass—Certified ...	4lbs.	„
	Paspalum dilatatum	8lbs.	„
	White Clover—Certified	2lbs.	„

As no conclusive results are yet available from the Variety Trials being conducted, the second year's report of which are recorded below, no alteration in these two mixtures is recommended.

SECOND YEAR'S RESULTS OF IRRIGATED SPECIES TRIALS UNDER CONTROLLED METHODS OF GRAZING.

The first year's results were published in the March, 1937, issue of this Journal.

J. Neil's Property, Waroona.

The area of the demonstration is 12.94 acres. This area was divided into five fields and a race, the area of the fields being as follows:—Fields Nos. 1, 2, 4, and 5, 2.39 acres each. Field No. 3, 2.5 acres.

The objects of the experiment were:—

1. To determine the most suitable plants for the establishment of permanent pastures under irrigated conditions on the soil type selected in this irrigation area.

2. The collection of data regarding the carrying capacity of these pastures on small irrigated areas.

3. To determine the actual yield per acre from the various mixtures under existing conditions.

Seed Mixtures.

Seed mixtures sown during mid-October, 1935, were as follow:—

Field No. 1. N.Z. Certified Mother Strain Perennial Rye Grass + N.Z. Certified White Clover 2 lbs. per acre.

Field No. 2. N.S.W. Handshaken *Paspalum dilatatum* 10 lbs. + N.Z. Certified White Clover 2 lbs. per acre.

Field No. 3. N.S.W. Handshaken *Paspalum dilatatum* 8 lbs. + N.Z. Certified Mother Strain Perennial Rye Grass 4 lbs. + N.Z. Certified White Clover 2 lbs. per acre.

Field No. 4. N.Z. Tall Fescue 2 lbs. + N.Z. Certified White Clover 2 lbs. per acre.

Field No. 5. Certified *Phalaris tuberosa* 4 lbs. + N.Z. Certified White Clover 2 lbs. per acre.

Fertilisers.

The total weight of superphosphate for the first year was 900 lbs. + 100 lbs. sulphate of ammonia per acre. During the past season 720 lbs. superphosphate has been applied per acre in four applications, the months being January, April, September, and December.

Cultivation.

Cultivation with the "Sunblade" pasture harrow was carried out in January and July, and on each occasion the pasture was stroked twice.

Irrigation.

The fields were irrigated at the following times during the last season:—8th January, 4th February, 24th February, 22nd March, 16th November, and 16th December.

Grazing.

The following table shows the grazing days which were obtained per month on each plot for the years 1936 and 1937.

TABLE 1.

COW GRAZING DAYS (8 HOURS) PER ACRE.

Month.	Field No. 1.		Field No. 2.		Field No. 3.		Field No. 4.		Field No. 5.		Average Grazing days per acre per month.	
	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.
January	....	20·9	....	41·9	....	40·0	....	41·9	....	20·9	....	33·1
February	13·4	20·9	13·4	20·9	12·8	20·0	13·4	20·9	....	20·9	10·6	20·7
March	....	21·8	....	42·6	....	20·7	....	40·1	13·4	21·8	2·7	29·4
April	26·0	16·4	13·0	16·4	12·8	16·0	13·0	17·2	13·0	16·8	15·4	16·5
May	....	....	....	....	....	....	....	....	....	....	....	....
June	14·6	19·6	14·6	19·6	28·0	17·2	29·3	22·1	14·6	36·1	20·2	22·9
July	....	36·2	....	39·1	....	18·2	....	39·0	....	36·2	....	33·7
August	....	9·4	17·6	9·4	33·6	24·6	17·6	9·4	17·6	18·9	17·3	14·3
September	35·1	15·7	17·6	15·7	....	....	17·6	34·5	17·6	15·7	17·6	16·1
October	30·1	42·2	48·4	49·0	32·6	37·2	48·4	43·6	64·2	42·2	44·7	42·8
November	18·8	27·2	36·0	20·4	16·7	39·2	18·0	6·8	18·8	40·8	21·7	26·9
December	38·5	34·5	38·5	34·5	54·8	52·2	57·4	41·1	76·2	34·5	53·1	39·3
Total	176·5	264·8	199·1	310·5	191·3	285·3	214·7	316·6	235·4	304·8	203·2	296·4
Average	14·7	22·1	16·6	25·9	15·9	23·8	18·9	26·4	19·6	25·4	16·9	24·7

Carrying capacity of whole area 1936 = 1 cow to 1.80 acres.

Carrying capacity of whole area 1937 = 1 cow to 1.24 acres.

Total grazing, 1937—

28,535 grazing hours from 12.94 acres.
2366.1 grazing hours per acre.
295.7 grazing days.

From the above Table it will be seen that no grazing was obtained from all fields for May, 1936-37. The average grazing days per month for 1936 was 16.9: the figure for 1937 was 24.7, which showed a considerable increase.

The various grass species in association with white clover gave the following average grazing per month for each year 1936-1937:—

	Grazing Days per Month. 1936.	1937.
Field No. 1.—Perennial Rye Grass	14.7	22.1
„ 2.—Paspalum	16.6	25.9
„ 3.—Perennial Rye Grass and Paspalum ...	15.9	23.8
„ Tall Fescue	18.9	26.4
„ 5.—*Phalaris tuberosa*	19.6	25.4

From the above it will be seen that, although there was not much difference in the amount of grazing obtained from each field, the perennial ryegrass and perennial ryegrass-Paspalum fields have given slightly lower yields during both seasons.

Yield of Green Material per Acre.

On 13th July, 1936, three moveable quadrats which enclosed 50 sq. links were erected and set on each field, and the pasture enclosed is cut at approximately monthly intervals. After cutting, the quadrats are set on a different area of pasture from that where the material was cut.

The following yields of green material per acre were obtained for the twelve months 9/12/36 to 16/12/37:—

Field No. 1 = 20.9 tons per acre.
„ 2 = 18.4 „ „
„ 3 = 19.0 „ „
„ 4 = 18.6 „ „
„ 5 = 17·3 „ „

The average production of green material per acre was 18.8 tons.

From the above it will be seen that there was very little variation in the yields per acre, but field No. 1 gave the highest, and field No. 5 the lowest yield.

The yields per acre for the same periods of 1936 and 1937 were as follow:—

Field No.	Period. 13th August, 1936, to 9th December, 1936.	20th August, 1937, to 16th December, 1937.
1	6·3 tons green	12·3 tons green
2	7·3 „ „	10·4 „ „
3	6·8 „ „	11·6 „ „
4	6·3 „ „	12·4 „ „
5	6·9 „ „	10·5 „ „

The average yield per acre for the four months 1936 was 6.7 tons, whereas for the same period 1937 it was 11.0 tons or 64 per cent. more

The figures for the three monthly yields for the different seasons of the year are as follow:—

Spring ...	...	6·36	tons green material	per acre.
Summer	...	6·76	„ „	„
Autumn	...	3·63	„ „	„
Winter	...	1·98	„ „	„

The spring and winter production from this demonstration was practically the same as that obtained from the irrigated experiment on the property of Mr. A. E. Jackson, but the summer production is about half, and the autumn less than that obtained on Jackson's property. It is expected that much higher yields will be obtained this season.

General.

Very little signs of "Dodder" were observed during the season, excellent control being obtained by using the pasture harrows during the winter months of the previous season.

The more efficient drainage which was provided during the winter of 1936 brought about a reduction of the obvious surface salt during the following summer and now a full ground cover of pasture has been obtained

C. H. Henning's Property, Hamel.

Full particulars as to the type of land and method adopted for sowing and cultivation are given in the March, 1937, *Journal.*

The objects of the experiment were the same as those of J. Neil, Waroona.

An area of 10 acres was selected and divided into 5 fields, 4 of which are under permanent pasture, the size of the fields being as follows:—

Field No.	1	=	2 acres.
„	2	=	2·06 „
„	3	=	1·79 „
„	4	=	2·39 „
„	5	=	1·79 „

Irrigation.

During last season four waterings were given, the dates being 13th January, February, and March, and 1st December.

Fertiliser.

Two applications were given during the season, the first one on 30th March at the rate of 320 lbs. superphosphate per acre, and the second on 27th September at the rate of 180 lbs. superphosphate per acre, giving a total of 500 lbs. per acre for the year. The application during the first year was 4 cwts. in two applications.

Cultivation.

The only cultivation carried out during the season was by the ordinary harrows, this being done on 29th March.

Seed Mixtures.

The seed mixtures sown were as follow. In each case certified white clover at the rate of 2 lbs. per acre was applied:—

Field No. 1. N.Z. Certified Mother Strain Perennial Rye Grass 8 lbs. per acre.

Field No. 2. N.Z. Certified Akaroa Cocksfoot 10 lbs. per acre.

Field No. 3. Certified *Phalaris tuberosa* 4 lbs. per acre.

Field No. 4. N.Z. Tall Fescue 8 lbs. per acre.

Field No. 5 has not yet been sown.

Grazing.

The following table shows the grazing days per acre which were obtained per month on each field for the years 1936 and 1937:—

TABLE 2.

COW GRAZING DAYS (8 HOURS) PER ACRE.

Month.	Field No. 1.		Field No. 2.		Field No. 3.		Field No. 4.		Average Grazing Days per month.	
	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.
January	....	53·0	....	21·1	....	10·4	....	24·1	....	27·2
February	6·9	28·0	6·9	49·0	6·9	40·5	10·3	46·6	7·75	41·0
March	6·9	32·5	3·4	45·1	3·4	50·6	9·4	57·5	5·78	46·4
April	15·8	26·0	19 7	31·5	19·7	21·6	19·4	19·1	18·72	24·6
May	11·8	47·0	7·5	38·7	3·9	48·4	11·4	46·2	8·65	45·1
June	....	26·0	....	25·0	....	27·0	....	10·9	....	22·2
July	....	13·0	....	....	....	7·1	....	....	....	5·0
August	....	24·0	....	23·2	....	26·6	....	25·0	....	24·7
September	....	24·0	....	23·4	....	20·0	....	25·0	....	23·1
October	52·0	22·0	42·5	37·5	38·0	40·0	53·0	53·0	46·38	38·1
November	79·0	62·0	....	56·2	66·0	50·0	151·5	37·5	74·13	51·4
December	48·2	53·2	125·7	106·2	58·0	56·6	125·7	72·0	89·40	72·0
Total	220·6	410·7	205·7	457·0	195·9	398·8	381·0	416·9	250·8	420·8
Average	18·4	34·2	17·14	38·1	16·33	33·2	31·75	34·7	20·9	35·0

Carrying capacity of whole area 1936 = 1 cow to 1.46 acres.

Carrying capacity of whole area 1937 = 1 cow to 0.84 acres.

Total grazing, 1937—

28,164 grazing hours from 8.25 acres.

3462.3 grazing hours per acre.

432.8 grazing days per acre.

From the above table it will be seen that, for 1936, no grazing was obtained for the four months June to September inclusive. In 1937 grazing was obtained each month of the year, but only 5 grazing days were obtained for the month of July. All fields are now in a condition that grazing can be carried out at any time of the year. Peak production is obtained from these plots during the months October to May inclusive.

The various grass species in association with white clover gave the average grazing per month for the twelve months of each year 1936 and 1937.

	Grazing Days per Month. 1936.	1937.
Field No. 1.—Perennial Ryegrass	18·4	34·2
„ 2.—Cocksfoot	17·1	38·1
„ 3.—*Phalaris tuberosa*	16·3	33·2
„ 4.—Tall Fescue	31·8	34·7

To date the indications are that all the fields are giving approximately the same grazing in their second season, although the Tall Fescue gave by far the most grazing during the first season.

Yields of Green Material per Acre.

As was the case on the previous experiment, moveable quadrats were erected on each plot. During the season 1937 the following yields of green material were obtained from each field:—

Field No. 1	=	32·9	tons per acre.
„ 2	=	28·2	„ „
„ 3	=	29·4	„ „
„ 4	=	31·4	„ „

The above show that relatively high yields per acre were obtained from the four fields, but field No. 2 gave the lightest yield of green material, although the amount of actual grazing obtained was higher than on any of the other fields. The grazing figures may tend to be on the high side, as during the winter and early spring there was a tendency on the part of the owner to over-graze the pastures.

The production of green material per acre for the same periods 1936 and 1937 is as follows:—

Field No.	Period. 13th August, 1936, to 9th December, 1936.	Period. 21st August, 1937, to 20th December, 1937.
1	12·7 tons green	17·7 tons green
2	11·1 „ „	14·1 „ „
3	10·6 „ „	15·2 „ „
4	8·1 „ „	15·8 „ „

It will be noted that there was a decided increase in yield of green material for this period in 1937 over that of the previous one.

The following figures give the three-monthly yields for the different seasons of the year:—

Spring ...	...	13·6	tons green material per acre.
Summer	...	11·3	„ „ „
Autumn	...	5·3	„ „ „
Winter	...	1·3	„ „ „

Here it will be again noted that the winter production is extremely low and that the highest production took place during the spring and summer months.

General.

During the winter a considerable amount of damage was done to the white clover on all fields by the lucerne flea. "Dodder" also was observed, but the whole area was not as badly affected as in the previous season. Close grazing of pasture during the winter months of 1937 checked the development of this parasite considerably.

Acknowledgment is made to Mr. C. Giles and Mr. A. Tindale, Dairy Instructors, for collecting the bulk of the field data given in this article.

"WITHER TIP" OR "SUMMER DIEBACK."

A COPPER DEFICIENCY DISEASE OF APPLE TREES.

By T. C. Dunne.

A disease of apple trees known locally as "wither tip" or "summer dieback" has been observed in a number of orchards in Western Australia for many years. The disease occurs mainly where orchards are planted in leached soil types such as sands, or the soils supporting the karri (*Eucalyptus diversicola*) forests of the south-western portion of the State. Either old or young trees may be affected, although in many cases where light surface soils are underlain by clay layers recovery of young trees has been noted after a few years.

SYMPTOMS.

Badly diseased trees are usually characterised by a stunted bushy growth habit due to the inability to develop a leader system.

The disease usually develops on vigorously growing shoots. During November or December brown spots appear on the terminal leaves. Small necrotic areas are next noted. Leaves developed thereafter are more severely affected and eventually wither and fall. This condition is followed by the withering and death of the upper portion of the shoot where three to twelve inches of growth may be affected (Fig. 1).

Apparently the buds on the shoot below the withered portion are quite healthy. Often during March new growths are produced from the uppermost of these buds. Following on winter pruning vigorous growth is usually obtained from shoots, the tips of which were withered the previous season.

The time of appearance and the severity of the disease may be modified by the seasonal conditions and by the district wherein the trees are located. Lateral shoots which cease growth early in the season seldom become diseased.

Of the commercial varieties of apples grown in this State "Yates" is definitely the most susceptible. Very often, trees of this variety are diseased when all other trees in the orchard are healthy. Young trees of the "Granny Smith" variety are also often diseased. In more unfavourable locations the disease has been noted affecting also the "Jonathan," "Cleopatra" and "Democrat" varieties. Where the diseased condition exists "Cox's Orange Pippin" which is grown only to a very limited extent, is usually very badly affected.

FIELD EXPERIMENTS.

A few years ago an outbreak of Black Scab (*Venturia inequalis*) was responsible for an orchard rather badly affected with "wither tip" to be frequently sprayed with Bordeaux Mixture. Following this treatment the trees made healthy growth and it was considered that the disappearance of the "wither tip" was due to the spraying.

Copper deficiency has been shown as a factor affecting the growth of citrus (5) and of Japanese plums (1) in other areas in the State. The possibility of the same factor being responsible for a blistering of the bark on "Granny Smith" trees had also been considered (2).

Responses to zinc treatments had been reported in 1936 in connection with mottle leaf of citrus (3).

Preliminary investigations were, therefore, begun to test the possibility of either a copper or zinc deficiency causing "wither tip."

A leader of "Yates" variety showing shoots affected with "wither tip."

SEASON 1936-37—

ORCHARD A—MANJIMUP.

A number of "Yates" trees about 12 years, and which were badly growing owing to the effects of the disease were selected. The following treatments were carried out:—

(a) *Soil Applications.*			
Copper sulphate	2 lb.	}	Applied 14th September,
Zinc sulphate	2 lb.	}	1936.
(b) *Trunk Injections.*			
Copper sulphate	A. R. Salt	}	Injected 14th September,
Zinc sulphate	A. R. Salt	}	1936.
(c) *Limb Injections.*			
Copper sulphate	Soln. 0.025% conen.	}	Injected 25th November,
Zinc sulphate	Soln. 0.1% conen.	}	1936.

(d) *Spray Applied to Leaves.*

Bordeaux mixture	3:3:40	Applied 25th November, 1936.
Zinc-lime mixture	3:3:40	

By March 1937 the differences between trees had become quite definite. All trees receiving copper treatments had shown considerable improvement. Although necrotic areas were common in many of the terminal leaves of copper treated trees, very few withered shoots were to be found.

Zinc appeared to have no beneficial effect, and in some cases shoots on trees treated with zinc were withered more severely than those on the controls.

On the control trees a large proportion of the shoots were badly diseased.

ORCHARD B—BRIDGETOWN.

The experimental trees were of the "Granny Smith' variety about four years old. Some shoots were beginning to wither before the treatments were begun. An attempt was made by injecting solutions of other salts to determine whether substances other than those containing copper would effect improvement. The following solutions were injected:—

(a) Copper sulphate	0.01% soln.	Injected 8th March, 1937.
(b) Manganous sulphate	0.05% soln.	
(c) Nickel chloride	0.01% soln.	
(d) Cobalt chloride	0.01% soln.	
(e) Mixture of above solutions each at one quarter concentration.		

Slight injury to the leaves was obtained with the cobalt solution and a little bark injury was noted with copper.

Observation at a later date showed that the disease had been arrested on trees receiving copper, but on all other trees additional shoots had withered.

SEASON 1937-1938—

ORCHARD A—MANJIMUP.

In this orchard soil applications, trunk injections of salts, and spraying treatments with copper and zinc were continued on the same trees used the previous year. In addition copper nails driven into the trunks of trees were tried as a method of supplying copper. Solution injections were discontinued owing to the injury caused by copper sulphate solutions of a concentration greater than 0.01%.

Complete recovery as shown by healthy growth, and the absence of diseased shoots has been obtained from soil applications or from trunk injections of copper sulphate. No benefit was obtained from the similar use of zinc sulphate.

The annual growth of the trees subjected to spraying treatments were showing signs of the disease at the time spraying was done (8th December, 1937). The one Bordeaux spraying of the previous year had no apparent residual effect. Following the 1937 spraying with Bordeaux mixture healthy growth was observed, but treatment with zinc-lime spray was not beneficial.

The copper nails had no effect in preventing the occurrence of the disease. All controls were affected.

ORCHARD C—MANJIMUP.

In this orchard a number of "Granny Smith" trees had always been badly affected by "wither tip," being only three to five feet high, although planted

several years. Affected trees were treated with salts of copper, manganese and zinc by means of soil applications, trunk injections and sprays. Copper nails were also used.

Except where the copper nails were used, all trees receiving copper were free from the disease during the first season. Withered shoots were observed on all other experimental trees including the controls.

Affected shoots before spraying, 7/12/37.

ORCHARD B—BRIDGETOWN.

In view of the satisfactory results with copper an attempt was made to induce recovery in shoots where the symptoms showed the disease to be in an advanced stage. The trees selected were of the "Yates" variety about 15 years old. Most of the shoots had not begun to wither although the young leaves were practically dead.

The trees were sprayed in early December with Bordeaux mixture and as a control with zinc-lime mixture. By the third week in January new healthy growth had been produced on the Bordeaux sprayed trees. No new growth was to be seen either on trees receiving zinc-lime spray, or on untreated trees where the shoots were badly withered.

The response to the copper treatment is shown in Figs. 2 and 3.

OTHER ORCHARDS.

Trials of a similar nature to those reported above have been conducted in other orchards. In some cases owing to the effect of seasonal conditions the controls have not been sufficiently diseased to allow of satisfactory comparisons, otherwise the results have been in accordance with those already reported. In no instance have copper treated trees been badly diseased.

ANALYSES OF LEAVES.

Copper determinations have been conducted on leaves collected from various orchards. In all cases leaves were taken from near the growing points of shoots, the uppermost four leaves being collected.

The figures obtained are given in the following tables:—

Table 1.

VARIETY—"GRANNY SMITH."

Orchard "B."	Copper p.p.m. on dry basis.
Leaves from affected shoots—disease not severe	3
Leaves from non-affected shoots—same trees as above	4
Leaves from non-affected shoots—healthy re-grafts on old butts	5
Orchard "Z."	
Leaves from healthy trees—clay subsoil	12

Table 2.

VARIETY—"YATES."

	Copper p.p.m. on dry basis.	
Orchard "A."	Collected Apr. 1937.	Collected Dec. 1937.
Leaves from affected shoots—control (a)	2	3.0
Leaves from affected shoots—control (b)	..	3.6
Leaves from shoots showing response to soil treatment with $CuSO_4$	3	4.0
Leaves from shoots showing response to trunk injections with $CuSO_4$	..	6.2
Orchard "X."		
Leaves from healthy trees—heavy soil	8	..
Orchard "Y."		
Leaves from healthy trees—medium soil	..	5.5

Table 3.

VARIETY—"GRANNY SMITH."

Orchard "C."	Copper p.p.m. on dry basis.
Leaves from tree 426a showing response to soil treatment with copper sulphate	5.1
Leaves from tree 426b showing response to trunk injection with copper sulphate	3.2
Leaves from control tree 427b—badly affected	1
Leaves from tree 431a showing response to soil treatment with copper sulphate	2.3
Leaves from control tree 432c—badly affected	1.2

Erratum.

DISCUSSION.

In 1928, Smith and Thomas briefly reported a disease of apple trees apparently similar to that described in this paper. It was stated that a response to soil application of copper sulphate had been noted (4).

In the field experiments reported in this paper definite response to treatments involving the use of copper sulphate was obtained. No benefit was produced by the use of other sulphates or by compounds of zinc, manganese, cobalt or nickel. The results indicated that diseased trees were suffering from an insufficiency of copper for normal growth.

Shoots after spraying, 20/1/38. Note bare stems whence affected leaves have fallen.

The analyses of leaf materials taken in conjunction with the above results warrant the conclusion that a copper deficiency was operative. Young leaves from diseased shoots were found to have a consistently lower copper content than more normal leaves. Where recovery was noted an increase in the copper content of the leaves as compared with affected controls was observed.

It is considered that differences to be noted in Table 2 between the copper contents of leaves collected from the same trees in following seasons is due to the earlier time of sampling in the 1937-38 season.

From the point of view of disease control it should be noted that in the case of older trees neither the soil applications nor the trunk injections of copper sulphate carried out in the early spring effected complete recovery the following growing season. It is possible recovery might have been obtained by the use of large quantities of material, but injury may have resulted. Applying Bordeaux mixture to the leaves produced immediate responses during the season of application, but no residual effect was observed the following season. With young or small trees all copper treatments gave very early responses.

It is suggested that where older trees are to be treated both soil and spraying treatments with copper be carried out the first year in order to ensure healthy growth. Thereafter soil applications of copper sulphate should prevent further occurrence of the disease.

The investigation has not been carried on over a sufficiently long period for information to be available concerning the quantities of copper sulphate or the frequency of applications needed for healthy growth.

It should be noted that the apple spraying programme practised in this State does not include the use of Bordeaux mixture. Had programmes similar to those used in countries where Apple Scab is established been in operation, it is unlikely that the "wither tip" disease would have occurred.

SUMMARY.

A disease of apple trees locally known as "wither tip" or "summer dieback" has been described.

Field experiments have been reported wherein treatments of affected trees with copper sulphate by means of soil applications, tree injections and sprays have given response.

No benefit was obtained from the use of other sulphates or from compounds of zinc, manganese, nickel and cobalt.

Copper analyses of leaves from affected and non-affected shoots showed a consistently lower copper content in affected leaves.

It was concluded that the disease is due to a lack of sufficient copper for the normal growth of trees.

Acknowledgment is made of the help of Mr. B. L. Southern, of the Government Chemical Branch, by whom all the copper analyses were conducted.

REFERENCES.

(1) Cahill, V.: "Experiments for the control of Exanthema in Japanese Plum Trees." Journ. Dept. Agric., W.A., 6: 388-394, 1929.

(2) Pittman, H. A. J.: "Exanthema of Citrus, Japanese Plums and Apple Trees in Western Australia." Journ. Dept. of Agric., W.A., 13: 187-193, 1936.

(3) Pittman, H. A., and Owen, R. C.: "Anthracnose and Mottle Leaf of Citrus in Western Australia." Journ. Dept. Agric., W.A., 13: 137-142, 1936.

(4) Smith, R. E., and Thomas, H. E.: "Copper sulphate as a remedy for Exanthema on Prunes, Apples, Pears and Olives." Phytopath. 18: 449-454, 1928.

(5) Wickens, Geo. W.: "Exanthema of Citrus Trees." Report of Proceedings Imperial Botanical Conference, London. 1924, 353-357.

AGRICULTURAL PROBLEMS.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and name of Advisers are as follows:—

Albany	H. R. Powell
Bridgetown	A. Flintoff.
Bunbury	M. Cullity.
Geraldton	N. Davenport (Government Buildings).
Gosnells	R. C. Owen.
Harvey	R. L. Cailes (Fruit); A. M. Tindale (Dairying).
Katanning	A. S. Wild
Kalamunda-Roleystone	W. H. Read, c/o. Department of Agriculture, Perth.
Kununoppin	W. M. Nunn.
Metropolitan, Gingin, Chittering ...	S. E. Bennett, c/o. Department of Agriculture, Perth.
Mundaring	V. Cahill.
Narrogin	A. T. Gulvin.
Vasse	J M. Nelson.

ALL-AUSTRALIAN EXPORT BACONER AND PORKER COMPETITIONS.

Entry forms in connection with the second series of these competitions being conducted by the Australian Meat Board are required to be lodged with the works managements on or before the 15th April next, and entries should be forwarded to works in time for them to be treated and shipped so as to arrive in London for judging on 15th July. Pig producers are reminded that such competitions provide important publicity for Australian pigmeats in the United Kingdom and that the reports of the judges on individual entries are a valuable index to the producers concerned of their achievement and a guide to the type required in the United Kingdom market.

The conditions are as follow:—

Each entry should comprise three pig carcases, including heads, bred and fattened by the entrant.

Only one entry of each particular breed or cross will be allowed from each entrant. The sire of the entry must be pure-bred and from a litter recorded by the Australian Stud Pigbreeders' Society.

Weights for baconer carcases should be not less than 120 lb. nor more than 160 lb. dressed and including heads. Weights for porker carcases should be not less than 60 lb. nor more than 90 lb. dressed and including heads.

Prize money totalling £25 is awarded by the Board to successful entrants and in addition a trophy valued at £10 10s. is competed for.

No entry fee is charged.

Entry forms are obtainable from the usual trade channels, and also on application to the Veterinary Officers of the Department of Commerce in each State, and from the office of the Australian Meat Board, at 419 Collins Street, Melbourne.

WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE.

LIST OF BULLETINS AVAILABLE FOR DISTRIBUTION.

No. 20.—*The Pruning of Fruit Trees.* J. F. Moody. Price 2s. 6d.
No. 38.—*Linseed or Flax and Its Cultivation.* Geo. L. Sutton.
No. 46.—*Fruit Packing and Marketing and Exporting of Fruit.* J. F. Moody and J. Ramage. Price 1s. 6d.
No. 57.—*Vermin Destruction.* A. Arnold.
No. 60.—*The Farmer's Clip.* J. J. Mahood.
No. 93.—*The Home Tanning of Sheep and other Skins.* H. Salt.
No. 101.—*Cotton Cultivation.* G. L. Sutton.
No. 113.—*Picked Pieces: Classification of Clip.*
No. 115.—*The Value of Windmills for Pumping Water in W.A.* A. H. Scott.
No. 121.—*Mildew Septoria Leaf Spots and Similar Diseases of Cereals.* W. M. Carne.
No. 122.—*Codlin Moth: Descriptive Account together with Notes on its Control.* L. J. Newman.
No. 126.—*The Rusts of Cereals.* H. A. Pittman.
No. 128.—*Woolly Aphis Parasite.* L. J. Newman.
No. 136.—*The Use of the Scythe.* H. Campbell.
No. 141.—*Breeding a Permanent Flock.* Hugh McCallum.
No. 143.—*The Zamia Palm and Rickets in Cattle and The Kerosene Method for Eradicating the Palm.* A. B. Adams and G. K. Baron-Hay.
No. 153.—*Eradication of Lice and Tick in Sheep.* A. McK. Clark.
No. 154.—*Branding the Wool Bale.* G. L. Sutton and N. Davenport.
No. 158.—*Thorn Apple.* W. M. Carne and C. A. Gardner.
No. 159.—*Bathurst Burr.* W. M. Carne and C. A. Gardner.
No. 160.—*Cereal Smuts.* W. M. Carne.
No. 170.—*Paterson's Curse.* C. A. Gardner.
No. 172.—*The Annual Birdsfoot Trefoils.* W. M. Carne, C. A. Gardner, and A. B. Adams.
No. 173.—*Braxy-like Disease of Sheep in Western Australia.* W. H. Bennetts.
No. 181.—*Branding of Stock.* A. Arnold.
No. 192.—*Root Rot of Fruit Trees due to Armillaria Millea.* H. A. Pittman.
No. 198.—*Spotted Thistle.* W. M. Carne and C. A. Gardner.
No. 213.—*Stinkwort.* W. M. Carne and C. A. Gardner.
No. 215.—*King Island Melilot.* W. M. Carne, C. A. Gardner, and A. B. Adams.
No. 217.—*Army Worms, Cut Worms and Web Worms.* L. J. Newman,
No. 219.—*Bitter Pit in Apples.* W. M. Carne,
No. 220.—*Irrigation.* A. R. C. Clifton.
No. 222.—*Spring Beetle Investigation.* L. J. Newman
No. 223.—*Pink Eye or Ophthalmia in Sheep.* A. McK. Clark.
No. 225.—*Subterranean Clover.* C. A. Gardner and T. C. Dunne.
No. 226.—*Cape Tulip.* W. M. Carne and C. A. Gardner.
No. 228.—*Root Rot and Foot Rot of Wheat.* H. A. Pittman.
No. 230.—*Bone Chewing and Toxic Paralysis of Cattle.* H. W. Bennetts.
No. 231.—*Grain Weevils.* J. L. Newman.
No. 251.—*Rutherglen Bug.* L. J. Newman.
No. 253.—*Drooping Flowered Clover.* T. C. Dunne and C. A. Gardner.
No. 254.—*Sorrel.* W. M. Carne, A. B. Adams, and C. A. Gardner.
No. 256.—*Climbing Cut-worm or Tomato Moth.* L. J. Newman.
No. 260.—*The Treatment of Bowling Greens, Tennis Courts and Lawns.* G. N. Lowe
No. 262.—*The Blow-fly Menace.* H. McCallum.
No. 266.—*The Blackberry Pest.* G. L. Sutton.
No. 270.—*Subterranean Clover Weevil.* L. J. Newman.
No. 271.—*Seaweed as a Fertiliser.* L. J. H. Teakle and L. J. Newman.
No. 272.—*Biological Control of the Silver-Eye.* L. J. Newman.
No. 274.—*Nut Grass.*—C. A. Gardner.
No. 276.—*Minerals in Pastures and their relation to Animal Nutrition.* J. B. Orr
No. 280.—*Fruit Thinning.* G. W. Wickens.
No. 283.—*The Eelworm-Gall or Root-Knot Disease.* H. A. Pittman.
No. 284.—*The Common Blue Lupin.* C. A. Gardner and H. G. Elliott.
No. 286.—*Honey.* H. Willoughby Lance.
No. 288.—*Pastures in Areas of Medium Rainfall.* G. K. Baron-Hay.
No. 289.—*The Unsound Economics of the F.A.Q. Standard for Selling Australian Wheat.* Geo. L. Sutton.

No. 290.—*Wax Scale* (*Ceroplastes Ceriferus*), Anderson. L. J. Newman, B. A. O'Connor, and H. G. Andrewartha.
No. 291.—"*Early Blight*" *or* "*Leaf Spot*" *and the Macrosporium* "*Storage Disease*" *of Potatoes.* H. A. Pittman.
No. 292.—*Cultivation of Onions.* E. T. Morgan.
No. 294.—*Best Kept Farm Competition—Manjimup.* M. Cullity.
No. 302.—*Hints on Bees and Their Management.* H. Willoughby Lance.
No. 306.—*Black Spot or Scab of Apples and Pears.* H. A. Pittman.
No. 307.—*Present Comparative Value of Feeding Stuffs.* G. K. Baron-Hay.
No. 308.—*Bee Hives.* H. Willoughby Lance.
No. 309.—*The Pollination of Orchards.* H. Willoughby Lance.
No. 310.—*The Wild Turnip.* C. A. Gardner.
No. 314.—*Bordeaux Mixture.* H. A. Pittman.
No. 315.—*Mexican Poppy.* C. A. Gardner.
No. 316.—*Bananas.* F. J. S. Wise.
No. 319.—*Cape Gooseberry.* G. W. Wickens.
No. 320.—*Agricultural Seeds and Their Weed Impurities.* H. G. Elliott.
No. 321.—*Cooling of Milk and Cream.* G. K. Baron-Hay.
No. 322.—*Feeding Wheat to Pigs.* G. K. Baron-Hay.
No. 323.—*Nitrogen Fixing Bacteria for Leguminous Plants.* H. A. Pittman.
No. 325.—*Apple Curculio.* H. G. Andrewartha.
No. 327.—*Wine-Making for Domestic Use.* H. K. Johns.
No. 330.—*Chemical Weed Killers.* G. R. W. Meadly.
No. 333.—*The Centrifugal Cream Separator.* G. K. Baron-Hay.
No. 335.—*The Export Lamb.* Price 1s.
No. 337.—*The Principal Insect Pests of Tobacco.* L. J. Newman.
No. 338.—*The Cleansing of Dairy Utensils.* G. K. Baron-Hay.
No. 339.—*The Apple Tree and Its Food.* Geo. L. Sutton.
No. 340.—*Standardising the Apple Pack.* A. Flintoff.
No. 341.—*Dentition of Sheep.* H. McCallum.
No. 343.—*The Apple Curculio.* H. G. Andrewartha.
No. 346.—*Relative Food Values.* G. K. Baron-Hay and L. C. Snook.
No. 353.—*The Canary Grasses of Western Australia.* C. A. Gardner and G. R. Meadly.
No. 354.—*Brown Rot of Citrus.* H. A. Pittman.
No. 355.—*Better Dairying Competitions.* G. K. Baron-Hay.
No. 357.—*The Pea Weevil.* L. J. Newman.
No. 358.—*Clover Springtail Lucerne Flea Investigation.* L. J. Newman.
No. 360.—*Web-Worm.* L. J. Newman.
No. 363.—*Apple Powdery Mildew.* G. W. Wickens.
No. 364.—*Dust in our Agricultural Wools.* H. McCallum.
No. 365.—*Home Felmongering Methods.* H. McCallum.
No. 366.—*Cheap Silage Conservation.* G. K. Baron-Hay.
No. 367.—*Rules Governing the Formation and Operation of Grade-Herd Testing in W.A.* G. K. Baron-Hay.
No. 370.—*Strangles in Horses.* H. McKenzie-Clark.
No. 372.—*Wheat—Is it a Suitable Food for Dairy Cows.* L. C. Snook.
No. 373.—*The Blackberry or Bramble.* C. A. Gardner.
No. 374.—*Points in Purchasing Seeds.* G. R. W. Meadly.
No. 375.—*Barley Smuts and Their Control.* H. A. Pittman.
No. 376.—*The Peanut—Its Cultivation in W.A.* F. J. S. Wise.

(Reprints from Journal of Agriculture, June, 1933.)

No. 377.—*Seeds and Seeding.* G. R. W. Meadly.
No. 378.—*Butter Making on the Farm.* G. K. Baron-Hay.
No. 379.—*Frost Injury to Wheat.* H. A. Pittman.
No. 380.—*Control of Black Spot or Scab of Pears.* Miss Joan Hearman.
No. 381.—*Insect Pests of Fruit Trees and Their Control.* L. J. Newman and B. A. O'Connor.
No. 382.—*Blow-fly Dressings and Branding Fluids.* H. McCallum and W. McC. Johnson.
No. 384.—*The Preparation of the Farmer's Clip.* H. McCallum and W. McC. Johnson.
No. 385.—*The Milking Cow and Her Pasture.* G. L. Sutton.

(Reprints from Journal of Agriculture, September, 1933.)

No. 386.—*Cow Peas.* G. K. Baron-Hay.
No. 388.—*Thrips Imaginis* (*Bagnall*). J. L. Newman, H. G. Andrewartha and B. A. O'Connor.
No. 389.—*The Cleansing of Milking Machines.* M. Cullity.
No. 390.—*Toxic Paralysis or Botulism.*

(Reprints from Journal of Agriculture, December, 1933.)

No. 393.—*Pica and the Evolution of a Stock Lick.* Geo. L. Sutton.
No. 395.—*Dairy Cattle Improvement Act*, 1922, *and Amendment Act*, 1932. G. K. Baron-Hay.
No. 396.—*San Jose Scale.* L. J. Newman.

(Reprints from Journal of Agriculture, March, 1934.)

No. 399.—*A Blower Elevator Attachment to the Chaffcutter.* Geo. L. Sutton.
No. 401.—*Virus Diseases of Plants.* H. A. Pittman.
No. 402.—*Some Studies in Churn Sanitation.* M. Cullity.
No. 403.—*Foliage Baiting and Trapping for the Control of Fruit Fly.* L. J. Newman.
No. 404.—"*F.A.Q.*" *Criticised, with a Suggested Alternative.* Geo. L. Sutton.

(Reprints from Journal of Agriculture, June, 1934.)

No. 406.—*Passion Fruit.* G. B. Barnett.
No. 407.—*Nitrogen Supply of an Apple Orchard.* L. J. H. Teakle, G. W. Wickens, and J. Pericles.
No. 408.—*Sorghum, Sudan and Johnson Grass Poisoning.* G. R. W. Meadly.
No. 409.—*Couch-grass Mite.* L. J. Newman.
No. 410.—*Better Dairying Competition.* G. K. Baron-Hay.
No. 411.—*Small Farm Wool-press.* H. McCallum.
No. 412.—*Vine Pruning.* H. K. Johns.
No. 413.—*Milk Sampling Equipment.* H. A. Pittman.

(Reprints from Journal of Agriculture, September, 1934.)

No. 416.—*Powdery Mildew of Roses.* H. A. Pittman.
No. 417.—*Determination of Age in the Horse.* A. Shilkin.
No. 418.—*Eulomo Packing Shed.* H. Tarlton Phillips.
No. 419.—*Chart Showing Price of Butter Fat.*
No. 421.—*Growing of Sweet Potatoes.* W. E. Collins.
No. 422.—*Sodium Arsenite as a Weedicide.* G. R. W. Meadly.
No. 423.—*Canada Thistle.* C. A. Gardner.
No. 424.—*Factors Influencing the Production of Clean Milk.* M. Cullity.
No. 425.—*Meadow Hay.* H. G. Elliott.
No. 426.—*Some Important Fungal Diseases of Grape Vines and Fruit Trees and Their Control.* H. A. Pittman.
No. 427.—*Grade Herd Recording, W.A.*, 1934. G. K. Baron-Hay.
No. 429.—*Mediterranean Fruit Fly.* L. J. Newman.
No. 430.—*Effect on Body Weight and Wool Growth of Feeding Sulphur to Sheep.* E. J. Underwood.

(Reprints from Journal of Agriculture, December, 1934.)

No. 434.—*The Dipping of Flocks as a Routine Practice in Sheep Raising.* Hugh McCallum.
No. 435.—*Cauliflower Production.* W. E. Collins.
No. 436.—*Denmark Wasting Disease.* J. F. Filmer and E. J. Underwood.
No. 437.—*General Management of Sheep.* Hugh McCallum.
No. 438.—*Vermin Poisoning.* A. Arnold and G. Herbert.
No. 439.—*A New Method for the Propagation and Distribution on a Solid Medium of the Cheese Starter Organism Streptococcus Cremoris.* H. A. Pittman.

(Reprints from the Journal of Agriculture, March, 1935.)

No. 440.—*Fumigation.—An Aid to Rabbit Extermination.* A. Arnold.
No. 441.—*Skeleton Weed* C. A. Gardner.
No. 443.—*Some Serious Plant Diseases in Western Australia which are brought about by Unusually High Temperatures.* H. A. Pittman.

(Reprints from Journal of Agriculture, June, 1935.)

No. 444.—*Fig Leaf Mottle.* H. A. Pittman.
No. 445.—*Fungicidal and Insecticidal Dusts for use in Market Gardens.* H. A. Pittman and L. J. Newman.
No. 446.—*The Pineapple.* G. B. Barnett.
No. 447.—*A New Noxious Weed—St. John's Wort.* C. A. Gardner.
No. 448.—*General Points in Selecting a Ram.* Hugh McCallum.
No. 449.—*The Better Dairying Competition, 1935.* G. K. Baron-Hay.
No. 450.—*Poultry Farming for the Beginner—Failures in Incubation.* G. D. Shaw.

(Reprints from Journal of Agriculture, September, 1935.)

No. 451.—*An Investigation of the Terrace Soils of the Gascoyne River at Carnarvon.* L. J. H. Teakle and B. L. Southern.
No. 452.—*The Bdellid Mite.* C. F. H. Jenkins.
No. 454.—*The Protein, Ash, Calcium and Phosphorus Content of Western Australian Cereal Grains.* E. J. Underwood and L. C. Snook.
No. 455.—*Irrigation Head Ditches.* R. C. Clifton.
No. 456.—*An Investigation of Plants Poisonous to Stock in Western Australia.* H. W. Bennetts.

No. 457.—*The Ploughing-in of Green Crops.* E. T. Morgan.
No. 458.—*Hoist for Lifting Hay or Green Material.* H. G. Elliott.
No. 459. *Oats in the Wheatbelt.* R. P. Roberts.

(Reprints from the Journal of Agriculture, December, 1935.)

No. 460.—*Self-Feeder for Pigs.* G. K. Baron-Hay.
No. 461.—*The Valuation of Australian Wheat for Commercial Purposes.* G. L. Sutton.
No. 462.—*Weedicides—Strengths of Application.* G. R. W. Meadly.
No. 463.—*Grade Herd Recording—Year ending 31st May,* 1935. G. K. Baron-Hay.
No. 464.—*The Selection of a Draught Stallion.* C. R. Toop.

(Reprints from Journal of Agriculture, March, 1936.)

No. 465.—*The Schopper Chondrometer and the Estimation of the Bushel Weight of Wheat Standard.* G. L. Sutton, L. J. H. Teakle and I. Thomas.
No. 466.—*The Value of Nitrogenous Fertilisers for Wheat in Western Australia.* L. J. H. Teakle and L. W. Samuel.
No. 467.—*Black Spot or Scab of Apples.* H. A. Jaques Pittman.

(Reprints from Journal of Agriculture, June, 1936.)

No. 468.—*Diseases of Bees.* H. Willoughby Lance.
No. 469.—*Wasting Disease—Diagnosis, Prevention and Treatment.* J. F. Filmer and E. J. Underwood.
No. 470.—*Ducks—Indian Runner and Khaki Campbell.* G. D. Shaw.
No. 471.—*Anthracnose and Mottle Leaf of Citrus in Western Australia.* H. A. Pittman.
No. 472.—*Exanthema of Citrus, Japanese Plums and Apple Trees in Western Australia.* H. A. Pittman.
No. 473.—*Better Dairying Competition,* 1936. G. K. Baron-Hay.
No. 474.—*Trees and Shrubs—Their Place in the Agricultural Districts.* C. A. Gardner.
No. 475.—*Castration Experiment—Comparison of "Burdizzo" and Knife Methods.* F. L. Shier and N. Davenport.
No. 476.—*Grade Herd Recording—Calf Marking Scheme.* G. K. Baron-Hay.

(Reprints from Journal of Agriculture, September, 1936.)

No. 477.—*Soil Erosion and Soil Conservation.* L. J. H. Teakle.
No. 478.—*Summer Fodder Crops in the Wheat Belt.* R. P. Roberts.
No. 479.—*Grade Herd Recording in Western Australia,* 1935–36. G. K. Baron-Hay and B. Williams.
No. 480.—*Silage, Ensilage and Silos.* Geo. L. Sutton.
No. 481.—*Common Ailments of Poultry and their Treatment.* G. D. Shaw.
No. 482.—*Stickfast Flea and Methods of Control.* L. J. Newman and G. D. Shaw.
No. 483.—*Fruit Industry in Western Australia.* Geo. W. Wickens.
No. 484.—*Fruit Fly—Ceratatis Capitata.* L. J. Newman and C. F. Jenkins.
No. 485.—*Measurement of pH Values of Butter Serum.* H. Kretchmar.
No. 486.—*Downy Mildew (Blue Mould) of Tobacco and its Control by Means of Benzol and other Volatile Hydrocarbons.* H. A. Pittman.
Apparatus for Application of Benzol. H. Kretchmar.
No. 487.—*Home-made Grab.* H. G. Elliott.
No. 488.—*Mammitis or Mastitis in Dairy Cows.* A. McK. Clark.
No. 488A.—*A Preparation of Wool for Market.* Hugh McCallum.
No. 488B.—*Pig Feeding Experiment on Tipperary Farm.* G. L. Sutton & G. K. Baron-Hay.
No. 489.—*Development of the Western Australian Wheat-belt.* R. P. Roberts.

(Reprints from Journal of Agriculture, December, 1936.)

No. 490.—*How we feed your Fowls.* G. D. Shaw.
No. 491.—*Useful Birds of Western Australia.* C. F. H. Jenkins.
No. 492.—*Dysentery in Bees.* H. Willoughby Lance.
No. 493.—*Carniolan Bees.* H. Willoughby Lance.
No. 494.—*Red and Brown Hard-pan Soils of the Acacia Semi-Desert Scrub of Western Australia.* L. J. H. Teakle.
No. 495.—*Soils of the Esperance Plain.* L. J. H. Teakle and B. L. Southern.
No. 496.—*Pigs—Breeding and Management.* G. K. Baron-Hay.
No. 497.—*Tangier Pea.* G. K. Baron Hay
No. 498.—*Tobacco Seed-bed Covers.* A. Sharp.

(Reprints from Journal of Agriculture, March, 1937.)

No. 499.—*Pasture Development.* G. K. Baron-Hay and H. G. Elliott.
No. 500.—*Lucerne—Queen of Fodder Crops.* G. L. Sutton and M. Cullity.
No. 501.—*Preventive and Combative Measures against Potato Moth (Pthorimaea operculella).* L. J. Newman and E. T. Morgan.
No. 502.—*Eggs—How to Forward them to Stores and Market.* G. D. Shaw.
No. 503.—*Sowing of Pasture Seeds.* G. K. Baron-Hay and H. G. Elliott.
No. 504.—*Bacteriological Count of Milk.* H. Kretchmar.
No. 505.—*Disinfection of Tobacco Seed.* H. A. J. Pittman.
No. 506.—*Hand Lever Boring Plant.* A. R. C. Clifton.

(Reprints from Journal of Agriculture, June, 1937.)

No. 507.—*Diseases of Farm Animals and Their Treatment.* A. McK. Clark.
No. 508.—*The pH Scale.*
No. 509.—*Takeall and Similar Diseases of Wheat and How to Control Them.* H. A. Pittman.
No. 510.—*Notes on Lamb Marking.* Hugh McCallum.
No. 511.—*Salt (Sodium Chloride) Content of Rainwater.* L. J. H. Teakle.
No. 512.—*The Farm Horse—Hints on Feeding.* A. McK. Clark.
No. 513.—*Refurnishing of Fruit Trees.* V. Cahill.
No. 514.—*Perching.* G. D. Shaw.
No. 515.—*Tobacco Seed-bed Management.* A. Sharp.
No. 516.—"*Rope*" *in Bread.* L. W. Samuel.
No. 517.—*Avoid Ill-treating the Lamb.* N. Davenport.

(Reprints from Journal of Agriculture, September, 1937.)

No. 518.—*Export Bacon Class—Royal Agricultural Show, 1936.* G. K. Baron-Hay.
No. 519.—*Western Australian F. A. Q. Wheat.* L. W. Samuel and G. E. Dean.
No. 520.—*Peat Soils and Related Soils of Western Australia.* L. J. H. Teakle and B. L. Southern.
No. 521.—*Fruit Industry in Western Australia.* Geo. W. Wickens.
No. 522.—*Rhizoctonia and Common Scab Diseases of Potatoes.* H. A. Pittman.
No. 523.—*Copper Deficiency—The Cause of Enzootic Ataxia ("Rickets") of Lambs.* H. W. Bennetts.
No. 524.—"*C-u-l-l-i-n-g*" *Spells* "*P-r-o-f-i-t.*" G. D. Shaw.
No. 525.—*Saline Soils of Western Australia and Their Utilisation.* L. J. H. Teakle.
No. 526.—*Invention of the Stripper.* Geo. L. Sutton.
No. 527.—*Tobacco-curing Barn.* A. Sharp.
No. 528.—*Tree Balsam or Gascoyne Poison.* G. R. W. Meadly.

(Reprints from Journal of Agriculture, December, 1937.)

No. 529.—*Geese.* G. D. Shaw.
No. 530.—*Peat Soils and Related Soils of Western Australia,* II. L. J. H. Teakle and B. L. Southern.
No. 531.—*Denmark Wasting Disease.* R. J. Harvey.
No. 532.—*Plague Grasshopper.* C. F. H. Jenkins.
No. 533.—*Soil Drift Reclamation by means of Lupins.* G. L. Throssell.
No. 534.—*Control of Toxic Paralysis (Botulism) in Sheep and Cattle.* H. W. Bennetts and H. T. B. Hall.
No. 535.—*Dairy Premises.* G. K. Baron-Hay.
No. 536.—*Bordeaux Mixture for Home Gardens.* H. A. J. Pittman.
No. 537.—*An Investigation into the Composition of Western Australian Wheatbelt Pastures and Stubbles.* E. J. Underwood, F. L. Shier, and R. J. Harvey.

The following publications may be obtained from the Department of Agriculture, Perth, on application, or will be sent post free to any address in this State on receipt of a remittance for the amount stated :—

The Management of Poultry under Western Australian Conditions, by W. T. Richardson, Poultry Adviser.

This is a most useful and valuable book, not only for beginners, but to all those who keep fowls for pleasure and profit. It deals fully with all matters connected with the industry, including Breeding, Feeding (for stock birds or egg production), Incubating, Brooding and Care of Chicks, Marketing (eggs and poultry), and all matters of use to the poultry-keeper. It also fully describes symptoms of various ailments and diseases and simple treatment for same, and, as the book was written to suit *local conditions*, every poultry-keeper should have a copy by him. Price, 2s.

The Pruning of Fruit Trees, by J. F. Moody, Fruit Industries Commissioner :

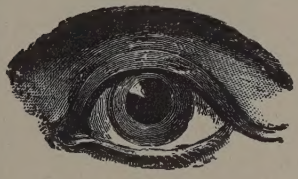
This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

Fruit Packing and the Marketing and Exporting of Fruit, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor.

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

Where Shall I Spend My Holidays?

SEE



WESTERN AUSTRALIA FIRST.

Health and Holiday Resorts Unlimited.

Full particulars obtainable from :—

GOVERNMENT TOURIST BUREAU

28-30 Forrest Place (opp. G.P.O.), Perth

Telephones: B 4376 and B 9121.
Cable and Telegraphic Address—"TOURIST PERTH"

Branch Offices:
Victoria Quay, Fremantle. Tel. L 2412.
Railway Station, Kalgoorlie. Tel. Kalg. 90.

SEYBERT J. HAYWARD, Director.